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ENGINEERING NEWS.

THE RUN OF THE PENNSYLVANIA LIMITED on May 19, 1889, from Fort Wayne to Chicago, has been officially published as follows:—Total distance 148.3 miles; time consumed, 2 hours, 59 minutes; average speed per hour, 49.7 miles; delayed, reduced speed and stops, 21 minutes; actual running time, 158 minutes; average speed running, 56.3 miles per hour. The fastest long distance run was 57.1 miles in 60 minutes; the fastest medium run was 29.2 miles in 27 minutes and the short fast run was 6.3 miles in 5 minutes and 20 seconds, or 71 miles per hour. The longest distance run for water was 84.2 miles. The engine weighed 91,900 lbs., had a 54-in. boiler, 18 x 24-in. cylinder, four drivers 62 ins. diameter, a tank capacity of 3,600 galls. The coal consumed 13,395 lbs. The train was made up of 1 combination, 1 dining and 3 sleeping cars; the total weight being 438,000 lbs. The road run over had ascending grades of 26 ft. per mile for 4.2 miles, 24 ft. for 4.3 miles, and 18 ft. for 3.2 miles. There were 23 curves, with a maximum curvature of 5° and an average of 2°.

THE MERCHANTS' BRIDGE, at St. Louis, is progressing as follows, according to information gathered from an interview with Messrs. Barr & Anderson, the contractors for the foundations:—There will be four main piers in the river, supporting two spans of 521½ ft. and one center span of 523½ ft. c. to c. of piers. At this date the caisson for Pier 1 (east side) is sunk and filled and the 27 ft. of concrete-filled cribwork on top is fast being finished and they will commence laying the pier masonry this week. Pier 4 (west side) is practically finished as the last pier masonry will be laid this week. Pier 2 and 3 are built and launched ready to tow into position and sink as soon as the stage of water permits. The caissons supporting these piers have extreme dimensions of 26x70 ft. for the two shore piers and 28x70 ft. for the center piers; they are all 17 ft. high and carry a crib filled with concrete extending to nominal low water mark. The depth from this low water mark to rock is 42 ft. on the west side and 48 ft. on the east, with a practically straight slope between. The lower chord of the bridge will be 50 ft. above high water. The contractors are, if anything, a little ahead of the contract time and every effort will be made to finish all the piers before cold weather, and perhaps erect some of the spans.

THE MIDLAND PACIFIC is the name of a new railway, which is projected to run from Pierre, Dak., west through the Sioux Indian reservation, the Black Hills, northern Wyoming, the Yellowstone National Park, Idaho and Oregon, to an outlet on Puget Sound. It is claimed by the projectors that the line will be about 200 miles shorter between Chicago and the Pacific coast than any now existing. About $50,000 of the stock has been subscribed and paid in. This money will be used in defraying the expense of surveys, which are now in progress under the direction of S. J. BELLS, of Dubuque, Ia., and GEO. M. NIX, of Sioux Falls, Dak., civil engineers. The route as projected passes through the almost entirely undeveloped plains of southwestern Dakota and eastern Oregon, and the comparatively sterile regions of northern Wyoming and Idaho. A more difficult route through these last two territories, as regards construction, could hardly have been selected. The promoters of the enterprise claim to be backed by a powerful syndicate. That this syndicate is the Illinois Central R. R. Co., however, is extremely improbable.

THE BEAR RIVER CANAL WORK, in Utah, and more fully noticed elsewhere, is one of the most extensive and costly irrigation schemes now in progress. MR. JAMES D. SCHUYLER, the engineer of the Sweetwater reservoir and other important works of this class, is the consulting engineer, and Prof. MEAD, the territorial engineer of Wyoming, is also connected with this work. Mr. FRED MATHYAS is the engineer in charge.

THE NICARAGUA CANAL CO. sent out a second construction party on June 23, on the steamer *Aguan* in charge of Mr. A. H. BALDWIN, C. E. The *Aguan* carries material for houses, rock-drills, tools, provisions, etc. She will also pick up laborers on her way out at Fortune Island. Civil Engineer LE BARON is in charge of the work at Greytown and to him this party will report.

THE AMERICAN ENGINEERS ABROAD were entertained on June 21, at the Eiffel Tower, by its famed engineer, and under his guidance inspected the structure.

A FUNERAL CAR has been added to the equipment of the N. Y. Central & Hudson River R. R. It cost $10,000 and will hold 40 persons besides the mahogany catafalque for the casket. It is to be used between New York and Woodlawn and other cemeteries, at a cost of $35 by regular train and $50 by "special."

THE BRAZOS RIVER IMPROVEMENT is said to be advancing with "clock-like rapidity" under Contractor WILKE'S energetic management. He expected to reach the bar with his jetties inside of Aug. 1. In this connection it should be remarked that in giving a somewhat detailed account of this enterprise in our last issue we should have also referred to a previous article of May 18, gathered from material furnished by Mr. GEORGE Y. WISNER, the engineer in charge.

LOWER WATER RATES is one of the advantages claimed by the Annexation Committee in favor of annexing Lake to Chicago. The rates in Chicago for a 20-ft. front are now lower than those for the same frontage in Lake, the first being $6.56, and the last $8.25, both net. Lake now takes its supply from the Hyde Park water-works, and the committee claim that the water is not only contaminated, by sewerage, but also that soon the Hyde Park tunnel will be capable only of supplying the Hyde Park works. Chicago has now a pumping capacity of 150,000,000 galls., with large additional pumps in process of construction, while her maximum daily consumption is said to be but 120,000,000 galls.

THE NEWARK, N. J., WATER BOARD has ratified the contract with the Lehigh R. R. Co. to furnish that city with pure water. The Common Council is yet to approve the transaction. It is reported that the railroad company and the J. R. Bartlett Water Supply Syndicate have come to an understanding and a division of dividends and profits. The East New Jersey Water Co. is to represent the Lehigh Valley Railroad Co. and is to furnish 50,000,000 galls. daily for $6,000,000, building all the necessary reservoirs, conduits, etc., for a gravity supply.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a triple collision of freight trains, June 26, on the Pennsylvania Railroad, near Latrobe, Pa. According to the press despatches, the Derry shifter had left 18 cars standing on the bridge while the crew was drilling out loaded cars at the Latrobe coal works. The flagman of the shifter had gone to the telegraph tower, but as a heavy rain was falling at the time, it is not known whether the engineer on the fast freight going west saw his signal or not. In any event, the flagman was not back far enough, and had his signal been observed the engineer could not have stopped his heavy train of 42 cars on the down grade in time to avert the accident. The train, going at a speed of 25 miles an hour, crashed into the cars on the bridge, tearing up the rails and ties, plunging over the side of the stone bridge, a sheer descent of 40 ft., into the bed of Loyalhanna creek. At the same moment an eastbound freight was passing on the other track. One of the wrecked cars caught the car next to the caboose on this train wrecking it, the caboose and the pushing engine; 18 loaded and 13 empty cars, together with one of the engines, were totally wrecked.

The wreck caught fire and was partly destroyed, but the fire was checked by the local fire department. Ten bodies have been recovered, and as a number of men from Johnstown were on the westbound train it is feared the total number of killed will be greater than this.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On June 16 several small bridges and trestles on the Northern Pacific in Washington and Montana were destroyed by forest fires; the Clark's Fork bridge, 600 ft. long, was burned June 24.—On June 19 a highway bridge at West Milton, N. Y., gave way under a team.—On June 20 the pontoon bridge at Sioux City, Ia., was much damaged by a heavy storm; 60 boats and part of the draw were carried away.—On June 26 a passenger train was derailed by running into a cow near the trestle over Crooked bayou, in Arkansas; the baggage, mail, and two passenger cars went through the trestle.

SEVERE STORMS have been experienced in Illinois and Iowa. A washout occurred on the Indianapolis, Decatur & Western near Atwood, Ill.—A landslide on June 25 blocked the Columbia & Port Deposit tracks with 5 ft. of earth for a distance of 60 ft.

THE OFFICE OF CONSULTING ENGINEER, on the new Croton Aqueduct, was not abolished at this week's meeting of the Commissioners. The letter of Mr. CHURCH, referred to in our last issue, was referred by the Mayor to Corporation Counsel CLARK, and this official decides against Gen. DUANE, concluding as follows:

> I am of the opinion that at the time Gen. DUANE was appointed an Aqueduct Commissioner by your predecessor he was ineligible to receive such an appointment, because he was then holding a Federal office, and consequently within the inhibition contained in the statute, and the appointment having been made in direct violation of the plain provisions of the act, it follows that Gen. DUANE is now unlawfully exercising the functions and discharging the duties of an Aqueduct Commissioner.

A motion to adjurn for two weeks' further consideration of the resolution abolishing the office of consulting engineer was adopted. We have commented upon this matter elsewhere.

THE CHESAPEAKE AND OHIO CANAL, on the Georgetown level, is to be put in order again at once, and the contract for so doing was signed last week. This contract is between the canal company and the millers who will sublet the work. The money to pay the sub-contractors is in hand, and it is expected that the mills can be in running order within 30 days. There is as yet little news regarding the reconstruction of the entire canal.

CHILIAN STATE RAILWAYS, according to the report of the Belgian Chargé d'Affaires at Santiago, have an extent of about 621½ miles, and private lines add 932 miles to this. The President will devote $31,250,000, borrowed from abroad, to the extension of railways, and the one line from Victoria to Osorno and Valdivia will consume about $17,700,000 of this sum. It is expected that several years will elapse before the connection between Buenos Ayres and Valparaiso will be completed.

THE REPAVING OF NEW YORK, under the late law appropriating $1,000,000 per annum for this purpose, is made the subject of a report to the Board of Estimates and Apportionment by Commissioner GILROY. For the streets most used for business he recommends granite block, with tarred joints and concrete base, as the best found after an experience of 15 years. For the streets devoted partly to business and partly for residence, he thinks asphalt on a substantial foundation is most suitable. Mr. GILROY points out the center-bearing rail as being particularly objectionable and the great cause of confining wheeled traffic to certain lines, thus causing ruts to be formed in the pavement. He believes that means should be adopted to compel the railroad companies to substitute for it a grooved or other rail, that would present neither a projection nor a depression, one that could be laid even with the pavement. The Commissioner presents a full list of the streets that should be first paved and an estimate of the cost of so doing.

Fireproof Floors.

At a late meeting of the Society of Engineers, says *Industries*, a paper was read on the above subject by Mr. G. M. LAWFORD, Assoc. M. Inst. C. E. After alluding to the concrete floors and roofs of the Romans, the history of fireproof flooring was briefly traced, showing how the brick arch gradually gave way to the different applications of concrete and wrought iron now in general use. The objects of fireproof flooring were stated to be as follows:

(*a*) To divide the building into a complete series of fire-resisting compartments.

(*b*) To gain strength, and in so doing to avoid lateral thrust on the walls, and to distribute the weight equally over them.

(*c*) To render the floors sound-proof, as well as fireproof, and

(*d*) To secure the building from both dry rot and damp.

Detailed descriptions were then given of the following types of construction as instances of modern practice:

(1) The concrete arch floor, illustrated by Dennett's and Wilkinson's systems.

(2) The flat, or suspended concrete floor, illustrated by Dawnay's, Lindsay's, and Gardner's systems.

(3) The arch block, or American floor, illustrated by the Doulton-Peto system.

(4) The flat brick, or French floor, illustrated by Homan and Rodger's system.

(5) The solid wooden floor, illustrated by Evans and Swain's system.

Several other systems were briefly described, as having been introduced from time to time with varying success, including those now in vogue in French and American practice.

After contrasting the individual floors, and the different types of construction, the two leading features for consideration were stated to be:

(1) Which system gave most protection to the iron work supporting the floor?

(2) Which of the different materials employed gave most resistance to fire?

On the first question, the solid wooden floor (Evans & Swain's), requiring no iron work for spans up to 30 ft., was considered to be the best; but next to it, and certainly in advance of the others on this point, was placed the Doulton-Peto floor, the hard burnt clay blocks, with their overlapping bases, forming a most efficient protection to the joist. There was little to choose between the arched and flat concrete floors, as in the former there were comparatively few joists dependent on a plaster covering, while in the latter there were from four to six times the number of joists, but completely encased in concrete; except in the case of Homan & Rodger's floor, in which both T irons and joists depended on a plaster covering. On the second question, a comparison was made between concrete in the different forms employed, brick work, terra cotta, and solid wood, and it was stated that for fire-resisting concrete, broken brick was preferable to coke breeze, as the action of intense heat tended to make burnt clay harder still, while coke breeze would calcine and burn away. The flat brick and terra cotta floors were both open to the objection that the floors were constructed in layers of materials differently affected by heat; but the terra cotta floor, giving better protection to the iron work, was entitled to the preference, while the solid wooden floor, though inflammable by nature, would probably give as much resistance as either brick, concrete, or terra cotta floors. A floor of the flat brick type, designed and patented recently by WILLIAM LINDSAY, Jr., deserved recognition, as apparently fulfilling the two requirements laid down by the author; but as it had not yet been used, criticism would be premature. It was, however, observed that the cost and weight were less than those of any of the similar floors in the appended table. The conclusion arrived at finally was that, although the floors described were capable of offering great resistance to fire, retarding its action by confinement, and in this way giving greater chances of extinction, a brick arch was the only absolutely "fireproof" floor, and that it would be more correct to describe the others as "fire resisting."

Brick Street Pavements.

(*Concluded from page 554.*)

The great diversity in the clays makes the process of manufacture a difficult problem, for the experience gained in one place may be of little or no use in another.

In several towns, notably Ottawa and Virden, Ill., manufacturers use the plant commonly employed for making tile, modified for bricks. At Virden, Ill., where the capacity is 1,600 per hour, the process is in substance as follows:

The clay hoisted from the mine is delivered from tramcars to a Blake crusher, and then finished in a dry-pan crusher. It is then delivered to a tempering machine, and forced from the latter by a screw through the desired mould, whence it issues in one continuous bar, 8½ ins. by 4¼ ins. in a section. It runs over a series of rollers, and is cut up by wires spaced 2 ins. apart, in a hinged frame worked by hand. The bricks are removed on tram cars to a dry house or shed, and left until sufficiently dry. They are then placed in down-draft cylindrical kilns, having hemispherical tops, and burned from 70 to 90 hours with bituminous coal on grates at intervals around the outside base. An 80 horse-power engine suffices for this plant. The heat is sufficient to melt tin and to cause pieces of copper to run together.

A and *B*, of dimensions 8¼ by 4¼ by 2 ins., are burned in the same kiln, but differ in color and quality. *A* is dark, almost black, rings more and appears stronger than *B*, which is a light red. They are quoted at $8 per thousand free on board cars. *C* is a brick from the same clay and made in the same way, but intended for a finished brick for the face work on buildings.

At Bloomington, Ill., the *A* clay is simply tempered in a vertical pug-mill, moulded into bricks by hand, dried in a yard, racked in rectangular stacks, and burned for from 96 to 120 hours with wood and bituminous coal placed in the usual arches. It is a grayish red in color, 7 by 3¾ by 2¼ ins., quoted at $8.50 per thousand at the yards, or furnished in sufficient numbers to lay *two* courses, one flat and the other on edge, for $1.12½ per sq. yd. Bloomington *B* and *C*, quoted at the same figures, have about the same dimensions. All have a sharp, clear ring when struck.

Bricks are made at Ottawa, Ill., from the fire-clay which is mined and from common surface clay. They are burned some 50 hours with bituminous coal, in kilns similar to those used at Virden. When burned the interior is dark gray in color, very hard, and cannot be cut with ordinary tools. They are of two dimensions, 4 by 5 by 12 in., and quoted at $1 per sq. yd., which is about $35 per thousand, and 4 by 4 by 12 ins., at 75 cts. per sq. yd., or about $28 per thousand.

At Empire, Ohio, a light-blue fire clay is taken from a drift in the side of a mountain, ground in a pan, moulded by hand, and burned in up-draft open-top kilns with natural gas. The bricks are hard, ring like steel, and are quoted at $10 per thousand. Much the same process is employed at New Brighton, Pa., where the brick made from fire clay are claimed to be as hard as granite, to emit a sharp, steely ring when struck, and to resist all effects except natural wear.

In all of the above cases no addition of sand or other material is made. In Wheeling, W. Va., a brick, in form of a truncated pyramid, is made from clay and iron slag.

As the condition and life of a pavement depend upon uniformity of the bricks, they should all be burnt to a uniform hardness, which cannot be obtained in ordinary kilns. If soft and salmon bricks are found at the top of the kiln, while those next the arches are over-burned, warped, and melted, the cost of the rest, suitable for use, is much enhanced by the waste.

In testing, all specimens were crushed by the direct application of weights. The specimens were all ¾ in. by ¾ in. by 1½ in., placed on end between pieces of soft pine about ¼ in. in thickness. The length chosen for the samples permits the shearing action to have its full effect. All were ground to true size on emery wheel and grindstone, and carefully calipered.

In Virden *A*, the short axes were parallel to the 8¼-in. and 4¼-in. dimensions of the brick from which it was taken. It was compact, having no holes or spongy places took on sharp corners and smooth surfaces, was excessively hard, and would glaze at a white heat on the emery wheel. With 5,266 lbs., it crushed by a scale of about ⅛-in. by ¾-in. by 1-in., first flying off from one vertical edge, accompanied by a sharp report, immediately followed by splitting into nearly prismatic fragments, parallel to the action of the force.

A second specimen from the same brick, with short axes parallel to the 4¼-in. and 2-in. dimensions of brick, crushed at 5,625 lbs.

Virden *B* did not take on as true dimensions as *A*, though free from holes. Crushed at 5,160 lbs.

Virden *C*, like the preceding, crushed at 4,985 lbs.

It was difficult to bring Bloomington *A*, as well as the next specimen, to the required dimensions, because of a tendency to scale, when heated under the action of the emery wheel. Several holes occurred in them, as may be seen in the bricks. They also glazed somewhat under the emery wheel. Crushed at 5,693 lbs.

The second specimen crushed in smaller prismatic pieces, at 7,208 lbs.

Bloomington *B* was excessively hard to reduce to size, would also glaze, but not scale off, took on smooth surfaces and sharp edges, and had spots which contained a yellow powder. Crushed at 5,565 lbs.

Bloomington *C* was much like the above. Crushed at 5,280 lbs.

In the following table are given the specific gravity (mean of 5 determinations) the absorption for three, five, and ten days, after the specimens had been heated to a red heat, cooled in a dissicator and weighed, and finally the crushing strength per square inch of section.

NAME.	Specific Gravity.	PER CENT. ABSORPTION. 3 days.	5 days.	10 days.	Crushing Strength. lbs. on sq. in.
Bloomington "A"	2.1852	3.79	3.92	4.06	12,920 max. 11,520 mean. 10,120 min.
"B"	2 3045	3·18	3·19	3.37	9,893
"C"	2.2269	1·87	2·20	2·70	9,386
Virden "A"...	2·3166	3.10	3·12	3·82	10,000 max. 9 680 mean. 9,361 min.
" "B"...	2.4150	7.67	7.96	8.71	9,173
" "C" ...	2·3601	7·11	7·48	8·70	8,862
Hayden Paving Block ..	2·2861	3.25	3·38	3.64	....

It may not be amiss to compare the crushing strength of the above with that of some common or building bricks.

Good Haverstraw stock bricks of a fair average, tested at East River bridge, by Mr. ABBOTT, with no packing between brick and machine, gave

		Crushing strength.
Whole brick on end.....	max.,	3,060 lbs. on sq. in.
	min.,	1,600 " "
	average,	2,065 " "
Half brick on flat side....	max.,	4,153 " "
	min.,	2,669 " "
	average,	3,371 " "
Half brick on small side..	max.,	6,400 " "
	min.,	2,900 " "
	average,	4,612 " "

Experiments by Prof. W. A. PIKE, Minneapolis, Minn., on building bricks. Half bricks between pieces of pasteboard.

		Failed with.
St. Louis, Mo., brick....	flatwise,	6,417 lbs. on sq. in.
	edgewise,	4,080 " "
Hastings red brick.....	hard,	2,017 " "
	medium,	2,012 " "
	soft,	1,748 " "

Paving bricks are sometimes laid on a foundation of broken stone covered with cement mortar, and sometimes on sand. It will hardly be expedient to go into details now.

At St. Louis, ten years ago, strips of pavement 22 ins. wide were laid down as a test, and a two-wheeled cart with tires 2½ ins. wide, and loaded to two tons, or 800 lbs. per in. of width, was rolled back and forth by machinery. The heaviest traffic at that time in St. Louis was 75 tons per day per foot of width, and the average for business streets was 35 tons. Estimating the effect of horses' shoes at one-third of this amount, 50 tons per ft. were used as a standard. The samples were weighed before and after testing, and were subjected to an amount of travel by the above cart equivalent to 8½ years on the street.

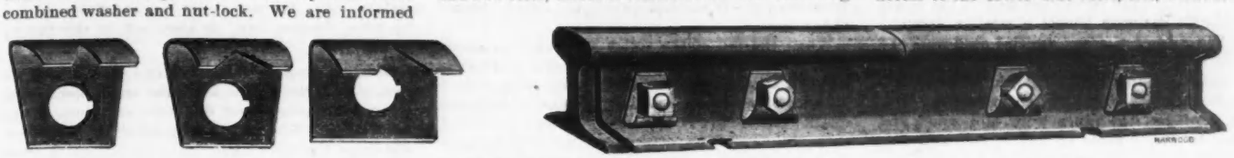
The total abrasion of the fire-brick pavement was 9 per cent., or a depth of ¾-ins., but about one-half of the bricks were broken. Asphaltum blocks under the same test wore 14 per cent., and but one was broken. Granite blocks were scarcely worn appreciably, while limestone had lost 10 per cent. The action of the elements would have affected the limestone still more, as would also probably have been the case with the bricks.

As a result, granite blocks were chosen for streets having heavy traffic. The tests seem to warrant the claim that brick pavements will answer well for moderate and light traffic.

Soft bricks intermixed may give trouble; but the first cold season will usually determine whether the bricks are hard enough, as, if not, the moisture absorbed by them will freeze, and crumble the bricks by expansion.

The Jones Nut Lock.

The accompanying illustrations show a new nut-lock which has recently been patented by T. D. JONES, of Syracuse, N. Y. As may be discovered from the cuts, the lock is made to fit any shape of nut. One of the principal advantages claimed for this device is that all the play of the nut is overcome before locking, and in that way it acts as a combined washer and nut-lock. We are informed



A New Nut Lock; T. D. Jones, inventor.

that this nut-lock has already had a thorough test on several leading lines, with satisfactory results. Further information can be obtained of the manufacturers, the Jones Safety Nut-Lock Co., Syracuse, N. Y.

[Of making many nut-locks there is no end, and we grow a little weary of studying their several peculiarities, but this lock certainly seems to have some points in its favor and to be worth trial.—ED. ENG. NEWS.]

Some American Metal Ties.

The International Tie.—This is a rolled steel tie, the section of which resembles a printer's "brace" (⌒⌒); originally it was made in two pieces, riveted together at the middle flange, but it is now to be rolled in one piece. The dimensions are as follows: Length, 8 ft.; width, 10 ins.; side flanges, 2¾ ins. deep; middle flange, 2 ins. high; thickness, from 3-16 in. at the lower part of the side flanges to 5-16 in. at the middle. The middle flange is cut away in two places for the rails. The fastenings consist of flat wrought-iron clips, one on each side of the rail, which are bolted to the flange of the tie and have projections which bear upon the rail flange. Some of these ties have been in use for more than two years on the Boston & Maine Railroad and the Maine Central Railroad; the Long Island Railroad is now giving them a trial.

The Hartford Tie.—This is a rolled steel tie, of inverted trough section, with a channel or groove along the whole length of the top table, and having the ends curved down to hold the ballast. The dimensions are as follows: Length, 7 ft. 6 ins.; width at top, 8 ins.; width at bottom, 10¼ ins.; depth 2⅛ ins.; thickness, ⅝ in. at sides and ½ in. at top; the channel or groove is 2¼ ins. wide and ⅝-in. deep. The weight is about 120 lbs. The fastening for each rail consists of two clamps ⅝-in. thick, with a hooked projection at the broad end, which holds the flange of the rail; these clamps are wedge-shaped in plan, and lie in the channel above mentioned. A bent bolt, with its head at an angle of 53 degrees with the body, is used on each side of the rail; the head is on the under side of the tie, and the body passes up through the tie and clamp, the nut bearing on the inclined face of the clamp. This is the fastening as improved by Mr. KATTE, the chief engineer of the New York Central & Hudson River Railroad. By this arrangement, the bolt being at an angle, a strong grip is secured, and there is little tendency to jar the bolts loose; to prevent such loosening, however, the bolt has the Harvey grip thread, which forms a nut-lock in itself. The fastening permits of a very wide range of adjustment of gauge. These ties have not yet been tried, but the New York Central & Hudson River Railroad will lay 800 of them in April, and careful observations will be made as to the results.

The Standard Tie.—This is a steel tie of channel section (⊔) stamped to shape from a plate. The bottom is cut away at the middle, and is bent up at an angle to offer resistance to lateral motion, the ends being open. The rail does not rest upon the vertical sides of the tie, which are cut away for a depth of ¾ of an inch under the rail, but rests upon a block of preserved wood (placed with the grain vertical). The tie is intended to be filled with ballast. The fastenings consist of Z-shaped clips, the upper part holding the rail-flange and the lower part taking a bearing on the under side of the bottom of the tie; the upright web is nearly vertical, but curved so as to grip the wood block. A bolt passes horizontally through the two clips and the block, near the top of the latter, holding all the parts firmly together. At the rail-joints it is intended to use a tie of extra width, with wide clips and two bolts, and it is claimed that this fastening will be sufficient in itself, and will obviate the necessity of using splice plates. These ties have not yet been in service, but arrangements have been made for their manufacture, and it is said that they will soon be tried on a Western road. The claim is made that they are specially adapted for roads with a narrow width of ballast, owing to the resistance to lateral movement being at the middle instead of the ends of the tie.

The Taylor Tie.—This is an iron or steel tie on the "bowl" system, each tie consisting of a separate piece under each rail, connected by a third piece forming a tie-bar. The rail-bearers are short pieces of inverted trough section, placed longitudinally with the rail, and have a vertical transverse slot through which the flat tie-bar passes. The inside flange of the rail is held by clips, forming a part of the top table of the trough, and the outside flange is held by a hooked projection at the end of the tie-bar. No bolts or other loose parts are used.

The Toucey Tie.—This is a cast-iron "pot" tie designed by Mr. TOUCEY, General Superintendent of the New York Central & Hudson River Railroad. Each tie consists of two "pots," of H section, with outward flaring sides; the "pots" are connected by a tie-rod, the ends of which are bent at right angles to fit into a hole in the horizontal web, the rod passing through a hole in the side. The "pots" are 18 ins. long, 9⅝ ins. wide on top, 16½ ins. wide at bottom, and 8½ ins. deep; the thickness varies from ⅛-in. to 1 in. The space above the web is filled with an oak block, to which the rail is secured by the Bush interlocking bolts. These ties are in use at the Grand Central Depot in New York City.

A Channel Tie.—A channel tie was used by the Pennsylvania Railroad for some years subsequent to 1880. In that year some were laid on the Filbert Street extension, and in 1885 about 400 or 500 were laid on the main track in the West Philadelphia yard. The tie consisted of an ordinary 7-in. channel iron (⊏) 8 ft. 6 ins. long; the ends were closed by a piece of angle-iron riveted on, and a cross-piece of angle-iron was also riveted inside the channel, just under the outer flange of the rail. The fastenings for each rail consisted of a piece of angle-bar, riveted through the face of the tie, the rivets passing through the angle bar tie and inside angle-iron on the outside of the rail, and a loose flat clip on the inside of the rail fastened by bolts. Writing in 1886, Mr. BROWN the Chief Engineer of the Pennsylvania Railroad, said:

> These ties cost from $3 to $4 each. As long as we can get good oak ties for not exceeding $1 each, I would not recommend making the change, although they give perfect satisfaction and are no more trouble to keep in line and surface than wooden ties.

The Durand Tie is described by Mr. B. E. FERNOW, Chief of the Forestry Division, as follows: This tie, among the latest patented in this country, has been in use on a private trial line in the French Alps. It resembles most nearly the Post tie.

It is produced by converting old rails into metal sheets, from which the tie is stamped out by special machinery, requiring no further shop-work than the fastening of the bolts, which are welded to the tie while hot.

The cross-section is of the Vautherin or Zores type, like the Post tie, narrowed and depressed in the center, and slightly curving towards the ends, as well as to the middle of the tie. Lengthwise corrugations on the face of the tie under the rail-seat, and if deemed necessary, vertical corrugations on the side-faces, are intended to give additional strength, allowing a saving of metal as against the Post tie. The width on top under the rail-foot is 10 ins., and across the lower edges 12 ins.

The ends are open, but can be closed if desired by a special cap, which is put on after the tie is placed, and can be easily removed if necessary, permitting access to the lower side-bolts, etc., without removing the tie entirely. Experience, however, with the open end type seems to have proved that the curvature of the ends is sufficient to prevent the blowing out of ballast.

The fastening of the rails is effected by means of four bolts with specially fitted T heads, which are inserted and partially welded to the tie from below during its manufacture, and are prevented from turning by a shoulder in the tie. A washer of soft metal is so adapted as to prevent any loosening of nuts above, an indentation on the lower side fitting into a similar indentation in the tie, and one flange being bent upward after screwing down. For curves, switches, etc., the adaptation of shape, inclination, and gauge is effected in the manufacture by interchangeable pieces in the stamping apparatus.

The placing of the tie is effected by laying it on the ballast, and burying it in the same by means of a rocking motion with the help of levers inserted into holes made at the ends of the tie in manufacturing. No digging of a tie-bed, no tamping, is needed. The drainage, a very important requirement is well provided for.

The weight of the tie is made variable by either rolling the metal-sheets to three-sixteenths of an inch, which gives a 65-lb. tie, or five-sixteenths of an inch, which will make it about 100 lbs.

The cost is claimed to be $1 or $1.35 respectively, if manufactured in the United States. The cost of manufacture is calculated at 30 cts., allowing a railroad company to use up the old rails. The plant for rolling the rails to shape and stamping the tie is simple; its cost is estimated at $5,000. The Durand tie, with less metal, promises to give the same strength, and is more easily placed than the Post tie.

* From a Report of E. E. RUSSELL TRATMAN, C. E., on "The Use of Metal Track on Railways as Substitute for Wooden Ties," made to the Forestry Division of the Department of Agriculture.

A Method for Determining the Capacity of the Waste-Weir of a Storage Reservoir on a Torrential Stream.*

The diagram which Mr. FTELEY has just made on the blackboard of the cross-section of the South Fork dam, as originally built, closely resembles the type of earthen dams which were built in 1830 and anterior by the canal engineers of New York, Pennsylvania, and Ohio. By correspondence, written and oral, a general plan of such dams was agreed upon among the engineers of that day.

The general features of these dams were a top width of 12 or 15 ft., carried up not less than 10 ft. above the bottom of discharge way of the waste, and slopes of 2 to 1 on each side. Where rock was used for the lower section of the dam, the lower slope was often reduced to 1½ to 1. The earth for the upper section, from the waste slope to beneath the rear top angle of the bank, was selected material (clay and gravel), put on in layers of 6 to 8 ins., moistened and compacted by the travel of the teams, as heavy, grooved iron rollers were then unknown.

Almost universally there was put in the center of the dam a puddle wall of clay and gravel, 6 ft. wide at a level 6 ft. above the water line, and increasing in width by steps of 1 ft. on each side of the puddle-wall, for a width of 10 to 12 ft. The tightest material, wet and compacted, was put in, and all of the remainder of the front (or water) slope was made of similar selected materials. Large stones,

* By WM. J. MCALPINE, Hon. M. Am. Soc. C. E.; read at the Annual Convention of the Am. Soc. C. E., at Seabright, N. J.

of more than 5 lbs. weight, were taken out of the front part and placed on the rear slope, over which turf, soil, and light materials were placed.

A gate-chamber of masonry was generally placed just within the front toe of the bank, and cast-iron discharge pipes were extended from this gate-chamber under the bank to a small gate-chamber at the foot of the outer toe of the bank. Sometimes these pipes were carried half way through the bank and discharged into a conduit of masonry, which conveyed the water through the remaining half of the bank. Mr. FTELEY'S diagram shows a similar arrangement. The cast-iron pipes which I used were of 8 to 12 ins. diameter, and connected by flanges, and were always laid upon and enveloped in a supporting wall of masonry with cross cut-off walls. Frequently, however, the pipes were laid upon and enveloped in heavy walls of puddle, and wide cut-offs of sheet-iron put in at the pipe joints to prevent the water following the smooth exterior surfaces of the pipes.

The puddling of that period was expensive, costing for the labor alone about 30 cts. per cu. yd. It was made of selected clay and fine double screened gravel in the proportion of one part of clay to two of gravel up to two parts of clay to one of gravel. These materials were thoroughly mixed, moistened (not wetted), and put on in layers of 6 ins., and cut with spades (not shovels), the cuts an inch apart and then cross cut, the workmen standing upon boards to guide the cutting and the spading extending into the cut puddle below. By measurements made at that time, this process compacted the material from its natural condition in the earth from 20 to 25 per cent., and in a month or two the mass became an artificial hard pan, over which water might run for some time without much abrasion.

Mr. JOHN B. JERVIS imported this method of puddling from England, and first used it on the Chenango canal in 1830. He directed me to train some of our inspectors in making the new puddle. One of these trained men, I believe, is now alive and well-known on the Erie Canal (J. HASBROUCK DECKER). Great care was taken to have the spillway of ample capacity, though there was no rule in practice to determine the size. If the hillsides at the dam were of rock, deep and wide trenches were cut as far away from the end of the dam as possible, to where a fall could be obtained, and then a walled channel built to conduct the waste water beyond the outer pool of the earthen dam. If the hillsides were of earth, the channels were walled with masonry and floored with timber and plank.

Frequently waste-gates were introduced at these spillways, but no reliance was placed upon them, as their usefulness depended upon uncertain human agency. The crest of the waste weir was usually a hinged plank on top of the masonry, which could be tripped by a blow of a long pole, and thus add a foot to the depth of the discharge.

The title of the short paper which I shall presently read is "A Method for Determining the Capacity of the Waste-Weir of a Storage Reservoir on a Torrential Stream."

I have been requested to precede this paper by an expression of my views in regard to the proper construction of dams for storage reservoirs on torrential streams, and particularly of those which the circumstances of the case require or render advisable, to be made of earth. I have so recently given publicity to my opinions on this subject, and heretofore in one of the sub-papers of the society, that I will now only occupy your time with general statements and refer to these papers for details.

The recent terrible disaster of the failure of an earthen dam at Conemaugh, Pa., has started in the public mind a distrust of all earthen dams similarly situated, which has been heightened by the publication of the alleged opinion of an eminent engineer, "that earthen dams should not be built on torrential streams." I am informed, however, that this distinguished engineer denies having expressed or entertained any such opinion.

On three-fourths of the water and hydraulic works in this country, there are existing dams of earth either for storage or reception. The latter, in most cases, are either within or contiguous to the towns and cities, and all at elevations far above that of the adjacent towns. Are these structures unsafe, or do any of them threaten disasters similar to that at Johnstown?

The foundations and circumstances of each case, if we should, as we ought, have regard solely to the safety of the structure, will determine whether a dam for storage upon a stream should be made of masonry or of earth. The considerations of economy should never enter into the question. It may, however, be remarked that the difference in the cost of such dams made of masonry or of earth is not great, when each one is selected to suit the circumstances of the case.

When the bed of the valley and its sides are as high as the proposed crest of the dam and is of water-tight rock, at or near the surface, the dam should be built of masonry, especially if stone of suitable quality can readily be obtained. When the bed and sides of the valley are of water-tight earth, suitable material for the artificial bank is certain to be easily obtainable, and then the dam should be built of earth.

When rock occurs, or is accessible on only a portion of the bed or sides of the valley, it will generally be found that the structure can be most safely made of earth, because in a dam of masonry it is one of the most difficult problems to change the foundation connections with rock to those with earth.

The failures of dams have been chiefly from the following causes:

First. In two thirds of the cases which I have examined, the failures may be traced directly to an improper construction of the outlet pipes or conduits, leading first to leakage, which, continually enlarged, ultimately causes a rupture.

Second. To an incomplete connection at the bottom and sides of the valley between the artificial and natural earths, both of which may be impermeable, and yet (not being properly united) may allow small leakages between them, first in films, which take up the firm earthy matter in solution, and thus continually enlarge the leak passage until finally the dam is ruptured.

Third. In earthen dams, from the want of sufficient water-waste plan, so that great floods fill the reservoirs to overflowing, and cause the sudden destruction of the dam. There are other causes of destruction, which I will not now stop to discuss.

Dams of masonry and of earth are liable to be ruptured from all of the above causes, though the last mentioned one is peculiar to those of earth, as destruction is certain, while in masonry it is rarely destructive.

The stability of a well-made earthen dam was remarkably shown at the late disaster at the Conemaugh. The original dam, built by the late W. E. MORRIS, after long years of neglect was ruptured some twenty years or more ago by leakages along the conduit which contained the discharge pipes. This breach was filled up in a moderately good manner, but the height of the dam was lowered two or three feet to provide a roadway on top.

At the great flood of May 31 the water in the reservoir had risen so as to flow over the earthen dam at 10 o'clock, A. M., and continued to flow over for 4½ hours before the whole dam gave way. It then yielded by scouring out only that portion of the earthwork which had been put into the former breach by a railroad contractor, and leaving that portion built by Engineer MORRIS intact. Even this less perfect work resisted the pressure of some 7 or 8 ft. of extra depth of water for 4½ hours before it failed.

I may here remark that if this dam had been maintained at its original height, it is probable that the increased depth of the spillway passage would have discharged the great flood without allowing the water to overflow the dam, and it would probably be now standing. I now return to my paper under its title proper.

It is assumed that the greatest quantity of water which will ever be poured into an artificial lake will be when the surface of the ground is frozen and covered with three feet depth of snow, and a rain of four inches depth, with a temperature sufficient to melt the whole of the snow, equal to four inches more of water, say in six or eight hours.

That the dam is of earth, with its crest ten feet above the bottom of the wasteway. The wasteway must have a capacity to discharge the above flood without allowing the water in the lake to rise higher than four or five feet below the level of the crest of the earthen dam.

From a good many observations of floods, I have noticed that the water in the tributary brooks of the valleys flows at the rate of 2 to 6 miles an hour, depending upon their rate of descent, the roughness of the bed, and the sinuosity of the stream; and that the surface water flows over the land to the smaller water channels at from an eighth to a mile an hour, when it is not too much obstructed by trees, bushes, etc., or absorbed in the thirsty earth.

In calculating the tables which follow, I have assumed that the sinuosities of the small brooks generally double the direct distance; and those of the land surface flowing waters quadruples the direct distances, but have made some exceptions to these rules, when the known circumstances warranted.

To show that these assumptions are approximately correct, I offer the following table of the *calculated* flow-off from the water-shed of the west branch of the Croton, as compared with the gauged flow-off as given by Mr. CROES in No. 87, Vol. 3, of the papers of the Am. Soc. C. E.

I am familiar with the topography of this water-shed, and I have divided it into 8 sections and 50 sub-sections, and have calculated by the foregoing rates the hours which the water from each of the sub sections would require to reach the weir, where the flood of Aug. 15, 1867, was gauged.

Within this water-shed are several lakes, ponds, and swamps, which receive the falling water and retard its overflow longer periods of time. I have made some allowances for this effect, but they are of too uncertain a character to be of much value. They do not, however, have much effect upon the general result.

TABLE I.

Hours.	Area sq. m.*	Millions of cubic feet flowing off				
		By Calculation.			By Gauge.	
		In each of 6 hrs.	Tot'l	Corrected for lakes, &c total.	In each of 6 hrs.	Tot'l
6	0.9	4.8	4.8	4.8	2.4	2.4
12	1.	7.5	12.3	8.7	6.	8.4
18	1.4	10.5	27.8	13.	9.5	17.9
24	2.7	20.2	43.0	35.	12.9	30.8
30	2.2	16.4	59.4	50.4	14.1	44.9
36	1.	7.5	66.9	57.9	13.2	58.1
42	.9	6.8	73.7	63.4	12.4	70.5
48	1.4	10.5	84.2	75.8	11.5	82.0
54	1.7	12.7	96.7	87.9	10.6	92.6
60	1.3	9.7	106.6	7.7	9.7	102.3
66	1.4	10.5	117.1	110.	8.8	111.1
72	.5	3.7	120.8	115.4	8.	119.1
78	.8	6.	126.8	122.6	7.	126.1
84	.6	4.5	131.3	128.1	6.2	132.3
90	.6	4.5	135.8	133.6	5.4	137.7
96	.7	5.2	141.0	139.8	4.6	142.3
102	.5	3.7	144.7	144.2	3.8	146.1
108	.5	3.7	148.4	148.4	3.3	149.4
114	1.6	4.5	152.9	153.4	3.1	182.5
	21.7				152.5	

* That this column may be better understood I will explain that in the first 6 hours the water from 0.9 sq. miles had passed over the weir; in 12 hours the water from 1 additional square mile had passed over, etc.

The rain of the 15th and 16th of August was 3.38 ins., and the measured flow-off from Aug. 15 to 20 amounted to 152,435,000 cu. ft., and in 19 days to 227,352,000 cu. ft. or 15 per cent. of the rainfall. Rains had been falling from Aug. 2, so that the ground was considerably saturated. The maximum flow from several other floods on this water-shed has been 6 or 8 hours after the rains had commenced.

The calculated and total measured flow up to the 12th hour was as 8.7 to 8.4 millions of cu. ft., up to the 24th hour as 35 to 30 million cu. ft., up to the 36th hour as 57.9 to 58.1 cu. ft., up to the 48th hour as 75.8 to 82 cu. ft.

I have also applied the same rates of flow to several small areas of water-shed (five to ten square miles), and by modifying them to suit the circumstances of the cases, have found that the calculations corresponded approximately with the measured flow.

Twenty years ago I applied rates, nearly like these herein stated, to a water-shed of 250 square miles, when the crest of the shed rose to 500, 600, and 700 ft. above the creek at the place where the dam was proposed to be built. The measurements, or rather the estimates, of the actual flow off were too vague

to render a comparison of value, though I used the table to determine the size of the wasteways.

In that case I subdivided the water-shed in sections of a mile square, and drew on my map rough, approximate, contour lines for each 50 ft. of elevation, and also the position of the main stream and the small tributary brooks.

The following is an abstract of these calculations:

In 3 hrs. the water from	10 sq. mls. of	the water-shed would reach the dam site.
6 "	56 "	"
9 "	34 "	"
12 "	32 "	"
15 "	44 "	"
19 "	32 "	"
21 "	22 "	"
24 "	12 "	"
27 "	6 "	"
	248	

About the same time I made a calculation of the flow from 60 sq. miles of the same water-shed as follows:

In 3 hrs. the water from	2 sq. mls.	would reach the dam site.
6 "	8 "	"
9 "	14 "	"
12 "	16 "	"
15 "	28 "	"
16 "	2 "	"
	60	

By applying any assumed percentage of the flowing off of the rainfall to the above areas, the 3 hour flood discharges will be given in cubic feet. The contents of the reservoir between the level of its top water line and a level 6 ft. higher (viz. to 4 ft. below the top of the earth embankment), will provide store room for a portion of the flood, and the weir or spillway must have a length sufficient to discharge the remainder of maximum quantities as indicated by the above tables.

In my practice I have always provided for the waste-water in two places to provide for the partial obstruction of one of them. Merely for the purpose of illustrating my subject, I have recently made similar calculations in regard to the South Fork Conemaugh water-shed, based upon a published map and assuming the crest line to be from 1,700 to 2,500 ft. above tide.*

On a plan of the water-shed I have drawn *assumed* contour lines at elevations of 100 ft. apart. If these were approximately correct, they would show the rates of slopes of the brooks, and to a considerable extent the land slopes.

The sections are a mile square, and the estimated hours of flow were marked on the brooks and also near the centers of each mile.

This table of the flood flow to the dam is based upon too much uncertain data to be relied upon, and yet I think its general results are useful, and will serve the object of this paper, which is to furnish the engineer with a *method* of determining the capacity of wasteways.

TABLE II.

Hours.	Square miles.	Mill. c.ft. for 8 ins. water.†
3	3	21
6	2	27
9	6	112
12	7½	140
15	6	112
18	5	93.6
21	3	56
24	4	75.4
27	4	75.4
30	2	37.6
33	¼	4.8
36	—	—
39	1	18.4
42	—	—
45	¼	4.8
48	—	—
51	1	18.4
	45	842.000,000

First trial, assuming a waste-weir of about 200 ft. length discharging in 3 hours, is as follows:

1 ft. depth	7 million cu. ft.
2 "	20 "
3 "	37 "
4 "	58 "
5 "	80 "
6 "	106 "

Each foot in depth of the reservoir above top water line will store about 18,000,000 cu ft.

*The base of the dam is about 1,500 ft above tide.

† For the first 3 hours the flow off was taken as equivalent to 3 in., for the first 6 hours, at 6 in., and for the first 9 hours at 8 ins.

TABLE III. (*First Trial.*)

Hrs.	Flood Mill. cu. ft.	Discharge by Spillway. Depth, ft.	Discharge by Spillway. Mill. cu. ft.	Stored in Reservoir. Depth, ft.	Stored in Reservoir. Mill. cu. ft.	Depth on Spillway, feet.
3	21		....	.	21	say 1
6	27	1	7	1	18	1
9	112	4	58	3	54	4
12	140	6	106+	2	36	6
15	112	6	106	.	..	6
18	94	6	106	.	..	5
21	56	5	80	.	..	4
24	75	4	58	.	..	5
27	75	5	80	.	..	5
30	38	4	58	.	..	4
33	5	1	7	.	..	0

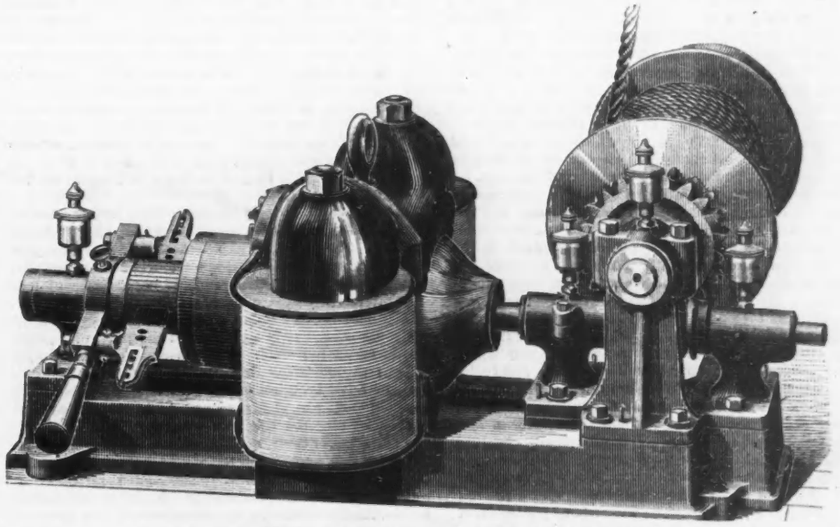
NOTE.—As this table is only given to show *the method* of calculating the length of the wier, the figures are not carried out accurately.

NOTE.—This first trial shows that the weir of the spillway should have been a little longer than 200 ft., to prevent the assumed flood from rising in the lake to nearer than 5 ft. below the crest.

The channel below the weir must, of course, have a capacity equal to that of 6 ft. of water over the weir. If the wasteway is merely a channel, it must have the same capacity as the weir.

An Electric Shell-Hoist for War-Ships.

The cut given herewith shows one of the electric shell-hoists built by the Sprague Electric Railway & Motor Co., of New York, for the U. S. cruiser *Atlanta*. This hoist is the first of its type built for work of this nature, and is indeed believed to be the first 3 H. P. electric hoist constructed in this country. It is fitted with the regular Sprague graphite brushes, and by the simple movement of an electric switch it can be run in either direction or its speed varied at pleasure.



The Sprague Electric Shell-Hoist; on U. S. S. Atlanta.

This shell-hoist is interesting as being still another departure in the direction of combining electro-motors with other machines in replacing steam; and the tendency among the leading electric supply companies seems to be to multiply machines of this nature. This same hoist, too, can be applied to many less warlike purposes than the one that gave it birth, and it ought to be particularly useful about the premises of an electric railway company which has ready at hand the power requisite.

THE AMERICAN ENGINEERS were, on June 27, formally presented by M. EIFFEL, to the Prefect of the Seine. Messrs. WHITTEMORE, TOWNE, and CHANUTE made short speeches, expressing their high appreciation of the fraternal reception that had been given to them and their associates by the French engineers. Their visit, they said, was primarily a manifestation of the deep sympathy felt by American citizens for France. The Prefect, in reply, complimented his guests and said their presence would tighten the bonds of a friendship which had existed for a century, and which was founded upon equal aspirations after democratic progress.

Address of Mr. Max J. Becker, President of the American Society of Civil Engineers, at the Annual Convention held at Seabright, N. J.

(ABSTRACTED.)

The provision of the by-laws of this Society which requires that its President shall deliver, at the annual convention, an address upon the progress of engineering during the preceding year, has been observed by my predecessors in various ways. While some of the former presidents have confined themselves strictly to the constitutional provision, by general reviews of the professional progress and scientific advancement of the period, others have dwelt more in detail upon some specific subjects of particular interest at the time. I trust I may be permitted, in this instance, to give you first a cursory glance of the field at large, and then confine myself more particularly to a review of the progress in that special part of the profession with which the long-continued performance of my official duties has afforded me opportunities to become more familiar.

Electrical Engineering.—Of the forces of nature, the one which has remained a hidden mystery longer than all the rest, but which of late has distanced all in the rapidity of its development, and which is certainly destined to excel them all in the extended range of its useful application, electricity stands pre-eminent.

In the prosecution of subterranean or subaqueous operations, such as tunneling, mining, sinking of caissons, the use of electric light is found to be of special benefit: in its incandescent form, it is absolutely safe against the dangers from explosive gases, and in caisson work it removes the risks and inconveniences incident to the ready and rapid combustion of inflammable substances under the influence of high atmospheric pressure.

Street Railways and Rapid Transit.—The rapid growth of our cities gradually forces the inhabitants to seek their homes in the suburbs and surrounding country, more or less distant from the business and manufacturing centres where their employment lies. The desire for economy of time, and the necessity for punctuality and prompt attendance, have led to the introduction of various modes of conveyance, beginning with the street-car tramways propelled by horses followed more recently by elevated railroads and cable-car lines, and still more lately by the electric railway, which latter system has, within a few years, developed much more rapidly than any of the preceding methods.

At the close of the past year, there were completed and in course of construction in this country, eighty-five electric railways, comprising about 450 miles of track, and the reports show that during the last year over eighteen millions of passengers have been carried over these lines.

The cheapness of original construction and subsequent maintenance and operation commend their adoption in smaller cities, where the older systems would be out of the question; and the practicability of their application in situations which could exclude cable lines and horse traction have led to their introduction in places like my own home, Allegheny City, where an electric railway is now in successful operation, which, in a distance of one mile out of a total length of four miles, ascends, with a speed of fully four miles per hour, a hill over 400 ft. high, upon gradient, of 12½ per cent. with numerous curves of 40 ft. radius

the cars being often loaded with 75 people. Upon the lower portion of this line the electric current is supplied by means of an underground current, and on the upper portion of the line by the ordinary overhead conductors.

But while undoubtedly the electric railway will be generally preferred in the immediate future, it is by no means to be inferred that the cable lines are to be considered as the motors of the past. On the contrary, their use will not only be continued, but greatly extended wherever the conditions and circumstances favor their adoption. Among the advantages which they possess are uniformity of motion, generally satisfactory speed, and the ease with which, in times of heavy travel, the vehicles can be multiplied and combined into convoys; and the facilities which they afford to converging horse-car lines, whose carriages they can attach to their own at the points of junction, saving thereby transfers to the passengers. The machinery used at the power houses of some of the principal cable lines is of very superior character, and some of the details employed are models of skill and ingenuity; noteworthy among these are the engines of the Brooklyn Bridge cable line, which many of us admired during the excursion at the time of the last annual meeting, and which are very interestingly described in a recent contribution to our "Transactions" by Mr. GABRIEL LEVERICH, one of our members, and at one time Secretary of this society.

Elevated railways, propelled by steam, must necessarily remain confined to larger cities, where the volume of traffic promises a return for the capital invested in their expensive construction, and where the distances to be reached are sufficiently great to make the saving of time, by means of their superior speed, an inducement for patronage.

Water-Works.—The introduction of water-works is now so extensive in this country that there are but very few cities or towns of more than 5,000 inhabitants which are not supplied with one system or another. The beneficial results upon the health of the populations are universally recognized, and the sanitary blessings and the advantages in point of comfort are beyond all calculation. Wherever additions and changes become necessary in the older cities, wise precautions are generally taken under the advice and direction of professionally skilled experts, to profit by former lessons, and to avoid the errors of the past.

The most extensive enterprises now in progress in connection with water-works extensions are the improvements embracing the new lake tunnels at Chicago and Cleveland, the new Croton Aqueduct in the city of New York, and the aqueduct extension in Washington, D. C. In all these cases, the question of greater purity has been carefully considered in connection with the increased supply.

The collection and storing of water supplies for large cities and manufacturing purposes require, in many cases, the construction of extensive reservoirs with massive dams for the retaining of the reserve supply. The importance of constructing these dams of proper shape and size, and of suitable material and good workmanship, so as to insure their absolute strength, and give them sufficient resisting capacity against every possible contingency, has been taught by a recent lesson of frightful experience; and while the responsibility for this calamity may not be placed upon the shoulders of the profession, yet it will be well for its members to look upon it and remember it as a warning and an example.

An investigation of the cause of the failure of the South Fork dam is now being made by a committee appointed under a recent resolution of this society, and is committee have just returned from a visit to the scene of the disaster.

Examinations and measurements of the structure and its surroundings, and extensive information obtained from various sources, will enable the committee to submit to the society in due time a comprehensive statement of the conditions and circumstances which have induced and contributed to this most disastrous failure.

Sanitary Engineering.—The extensions and improvements of the water supplies of our cities naturally lead to the adoption of measures for the disposal of sewage. The respective merits of the different methods employed for this purpose have been very ably presented to the profession, from time to time, in occasional contributions to our Transactions, by several members of this society, who stand pre-eminent in their special calling; so that all that would seem now necessary, in an emergency, is the exercise of sound and impartial judgment in the adoption of the proper method for each special case.

The system most generally used in this country now, and which will no doubt be preferred for a long time to come, is that of common water-carriage, by means of the so-called "Combined" plan of discharging all sewage and storm-water together through common outlets into adjacent rivers, lakes, or tidal waters. The objectionable features of this method consist in the pollution of the streams and lakes, from which, in turn, the water supply may have to be drawn; and the injurious effects caused by the deposit and periodical exposure of offensive matter upon the shores of tidal waters.

In order to overcome—at least partially—these objectionable features, modifications of this method have been tried, consisting in a filtration and chemical purification of the sewage so as to reduce the offensive portions and to render their final deposit into the streams of the district comparatively harmless. The methods employed for some time at Pullman, Ill., and more recently at Orange, N. J., are samples of this system.

Under the provisions of a law passed by the Legislature of Massachusetts in 1886, the State Board of Health is authorized to investigate, through a commission of experts, the effect of sewage discharge upon the streams and inland waters of the Commonwealth, and to recommend to the courts annually plans in remedy of existing evils. Acting upon the reports of this board, several cities are now making preparations for the disposal of their sewage by various methods of purification and dilution. In connection with some of these systems, the fluid portion of the sewage is utilized as fertilizer of farm land.

By the general introduction of natural gas as a domestic fuel, in Pittsburg and other Western cities, a large amount of kitchen garbage and house sweepings, which heretofore were regularly burned with the solid fuel then in use, can no longer be disposed of in that way; and after various unsuccessful attempts to bury them, deposit them in the rivers, and burn them in open air, a number of specially designed furnaces were built for the destruction of these accumulations, to which are now added the offal from slaughter-houses, the leached-out bark from tanneries, and all garbage from the public markets. The heat created by the combustion of these waste substances is successfully utilized for generating steam in boilers attached to the furnaces, which, without the addition of any other fuel, except what is required for ignition, supply the motive power for operating the machinery in adjoining factories; so that these establishments not only improve the sanitary condition of the communities by the prompt and radical destruction of vegetable and animal refuse, otherwise liable to decay on our hands, but also furnish a cheap fuel supply for industrial purposes.

Streets and Highways.—Nearly all the larger cities of this country have now passed the experimental stages of their street paving experiences, and have by this time entered upon a period of more permanent and substantial improvement in that department of municipal engineering. The days of wooden roadways, the Nicholson, the cedar, and locust blocks, will soon be remembered only as things of the past, like plank roads of earlier date. The various compounds with which, at one time or another, nearly all our city streets have been plastered over and poulticed, have cracked and split, shrunk, melted, and evaporated, and carried off piecemeal, in course of time, by the persistent adhesion of their ill-flavored mixtures to the bootheels of the weary pedestrians in hot weather. The abominable cobble-stones, which have jarred our nerves and dislocated our spinal columns in years gone by, are finally relegated to the by-streets and back alleys. Such makeshifts may answer the purpose for a while in new towns of rapid growth, where better materials are not readily attainable, and where first cost is a paramount consideration; but they should never be renewed to the extent that they often have been in spite of the most convincing experience and contrary to the best counsel of professional advisers. The sums of money wasted in repeating these mistakes would, in many instances, have gone far towards carrying out much more permanent and substantial improvements.

For streets in the vicinity of freight stations or of manufacturing establishments employing heavy teaming, and for streets with steep gradients, pavements should be made of stone blocks of basalt, trap rock, granite, or hard limestone, laid upon a bed of broken stone ballast, topped off with sand or fine gravel, well rammed, and joints filled with cement grouting or coal tar; for streets used by lighter traffic or carriages only, a well-laid pavement of pure asphalt upon a bed of stone ballast answers the purpose very well, if prompt attention is given to the maintenance and necessary repairs; for parks and suburban pleasure drives, a good macadamized road, well drained, and constantly kept in good condition, affords a very superior and comfortable highway.

Of late years, pavements of hard burnt fire-clay brick have been extensively laid in many cities and towns of the Middle States, where the supply of this material is very abundant and remarkably cheap. In some towns of West Virginia and eastern Ohio, such pavements have been laid for less than a dollar per square yard: they make smooth roadways, are easily kept clean and last very well under moderately heavy traffic. This pavement is especially well adapted for cities of medium size, which cannot well afford more expensive kinds, and yet require something more substantial and durable than either asphalt or macadam.

But if there is one thing which needs reformation more than any other, it is the condition of our common county roads. If it is true that the highways of a people are a measure of its civilization, then we cannot complain if we are classed as an inferior type of low barbarians. The good nature with which we submit to the imposition of the Annual Road Tax is only equalled by the sublime resignation with which we accept the result of the effort which swallowed up our money. Our Western members all know what is meant by "working the roads." It means to plow a furrow on each side and scrape the mud into a ridge in the middle, simply to be washed down again into the ditches by the first shower of rain. And this performance is repeated year after year, under the provisions of our statutes, and by the consent of a law-abiding but much-suffering people. During the spring and fall, we struggle through the mud manfully as best we can, and when winter comes, and the bottom literally drops out of the roads, we quietly compose ourselves and contentedly stay at home.

Some years ago, while out on an exploring expedition for a railway in Southern Ohio, I was compelled to hibernate, so to speak, with my entire party for nearly a month, in a lonely village among the hills of Wills Creek in Noble county, and when I made an effort to advise my employers of our situation, I was cheered by the comforting assurance of the postmaster that my letter would certainly go out just as soon as the roads dried up.

A faint ray of hope, however, is just beginning to dawn in some parts of the country, most conspicuously in Ohio, where, under the provision of a recent law, a number of free turnpikes are being built, of quite a superior character, by special tax levied upon the adjacent property.

The beneficial results of this wise system of improvments are very great and highly appreciated by the people, and it is sincerely to be hoped that other States will profit by the example.

Canals and Hydraulic Engineering.—The days of ordinary canal navigation in the interior parts of this country may well be considered as numbered with the past. With the exception of the Erie canal, which still maintains, to some extent, its character as a waterway of commerce, and excepting some parts of the canals in Eastern Pennsylvania, New Jersey, Maryland, Ohio, and Illinois, these primitive transportation lines have either been abandoned entirely, after out-living their short period of usefulness, or they are now merely utilized for carrying bulky products between local points, or for the supply of hydraulic power to manufacturing establishments.

Still more discouraging are the immediate prospects for the various maritime canal projects. The Panama canal, upon which very large sums of money have been expended, has finally been abandoned after many unsuccessful efforts of its projectors to raise the funds still required for its completion, and after, as a last resort, modifying the original plans of a sea-level canal to one with locks. But notwithstanding this momentary failure, I most sincerely hope—and I honestly believe—that it is yet reserved for American engineering skill and American enterprise to resurrect and successfully carry forward this great and important project to its ultimate completion. The Tehuantepec Ship Railway, which, for the purpose on hand, may properly be classed with the maritime canals, has not met thus far with the encouragement which its importance and the unqualified indorsements of eminent professional talent would seem to justify.

Probably the sad fate of its Panama rival which places it for the present out of the range of active competition, may assist in reviving the ship railway project, to which our lamented fellow-member, Captain EADS, devoted his energies during the last years of his useful life. New interest is being manifested in the old ship canal project across the Isthmus of Nicaragua, which, in the matter of demonstrable feasibility undoubtedly has many points in its favor.

Among other ship canal projects in active progress may be mentioned the Cape Cod canal, which was commenced in 1880, and which will, when completed, connect the Bay of Cape Cod, by way of Herring river, with the head of Buzzard bay in Massachusetts.

The magnificent success of the Sault Ste. Marie ship canal not only as an engineering project but also as a commercial enterprise, has surpassed all expectations and since its completion the traffic upon the Northern lakes has been multiplied to such an extent that it has been found necessary to build an additional canal and a new lock of larger dimensions even than the one now in use. The direct impulse given by the completion of this canal to the lake navigation, and the indirect effect upon the general business of that region of country has stimulated the work on the hydraulic canal at Sault Ste. Marie, from which great results are expect-

ed, and it has also hastened the operations in progress for deepening and widening the channels through the shallow parts of Hay lake, whereby the route from Lake Huron to Lake Superior will be considerably shortened and generally improved.

A project is now being agitated contemplating a direct connection between Lake Superior and Lake Michigan across the narrow portion of the peninsula between Marquette and Escanaba, whereby the passage through the Sault Ste. Marie would be entirely avoided and much distance saved for the traffic between Lakes Superior and Michigan.

In the extension of the river walls in New York harbor, under the Department of Docks, large concrete blocks are being used, weighing from 60 to 75 tons, and requiring hoisting machinery of extraordinary size and power to place them in position. Similar blocks are being placed in the walls along the lake front in Chicago, where they have been found to resist effectually the action of the waves in places where all former methods of protection have failed.

Railroads.—Sixty years ago railroads were unknown in this country. At that time the population of the United States consisted of 12,000,000 of people. To-day we operate 160,000 miles of railroad, and our population has increased to 60,000,000 of people. In 1830 the aggregate wealth of the United States was less than $1,000,000,000; at present it is estimated at $56,000,000,000. Just how much of this phenomenal prosperity may be due to the railroads it is, of course, impossible to conjecture, but it may be safely assumed that they have very largely contributed to the result. While the population has increased during the last fifty years about 35 per cent., the ratio of increase of the railroad mileage for the same period has been nearly four times that of the population, which would seem to indicate that they have not only supplied a want of the past, but have kept well up with the contemporaneous growth of the country, if they have not, indeed, advanced beyond its actual necessities. The railroad mileage of the United States is now fully one-half that of the total railroad mileage upon this globe, while our population is only about one twenty-fourth part, and our area of territory only about one-twentieth part of that of the inhabited world.

You have all heard the familiar illustration about girdling the equator a dozen times, more or less, with our railroad tracks; but it will no doubt please you to know that since you heard the statement last enough additional rail has been laid to give the equator another twist, and I might further supplement the illustration by the assurance, that we have now a sufficient supply of materials in the tracks of this country to build a railroad to the moon. Over these 160,000 miles of railroad we have carried last year 475,000,000 of people and transported 600,000,000 tons of freight. Upon these lines are engaged 1,000,000 employes. Their equipment consists of 30,000 locomotives, 21,000 passenger cars, 7,000 baggage cars, and 1,000,000 freight cars. The capital invested in their construction and equipment amounts to $8,000,000,000, and the yearly disbursements for labor and supplies exceed $600,000,000.

The creation of these vast properties has been accomplished by aggregation rather than by preconcerted systematic development. The trunk lines of the present day are to a great extent composed of pieces of road, originally built by local enterprise, and absorbed from time to time by lease or purchase, to constitute, with other acquisitions, in connection with some specially constructed connecting links, the various systems under the management and control of the leading railroad companies of the country.

The numerous accidents which happen at points where public highways cross the railroads at grade, in spite of alarm bells, watchmen and safety-gates, have led to the enactment of laws in some of the Eastern States, looking towards a gradual abandonment of existing crossings and the absolute prohibition of new ones in the future. During the years 1887 and 1888 there were abolished in Connecticut 93 grade crossings at a cost of $625,000. In Massachusetts a special committee of the Legislature has recently reported upon this subject, recommending that all dividend-paying roads eliminate annually 5 per cent., and all non-dividend-paying roads 2½ per cent. of their grade crossings at the joint expense of the railroads and communities, and that in future no grade crossings shall be permitted. It is to be hoped that the beneficial results of these wise measures will induce other States to take this subject under serious consideration.

The most noteworthy engineering feature in connection with the general progress of railroad construction in this country is the building of bridge structures upon a constantly increasing scale. In 1862 I triangulated the positions and laid the foundations for the piers of the channel span of the Ohio river bridge at Steubenville. This was the first iron railroad bridge over any of the navigable tributaries of the Mississippi river. The length of its channel span was 320 feet, and it was the longest iron truss ever attempted up to that time. It was designed by Mr. J. H. LINVILLE, still a member of this society, and it has carried in safety, and without accident, the traffic of one of the principal Western connecting lines of the Pennsylvania Railroad for twenty-five years, and is now being replaced by Mr. HENRY G. MORSE, also a member of this society, to make room for a double-track structure. To-day twelve railroad bridges span the Ohio river between Pittsburg and Cairo, and two more are in progress of construction. There are fourteen railroad bridges over the Mississippi, and fifteen over the Missouri. Many of these structures have spans of 500 feet, and one of the projected bridges over the lower Mississippi was designed with a span of 730 feet; but this plan, I understand, has been abandoned, and a cantilever structure adopted in its place.

The erection of these large bridges has become a special business in this country, and the leading contractors engaged in the pursuit have acquired wonderful skill in the performance of this dangerous and difficult work. Few people appreciate the risks and hardships encountered, and the courage and judgment required in dismantling an old railroad bridge and erecting a new one in its place, with a deep and rapid river running underneath, a strong wind blowing, and a hundred trains passing daily over the frail, temporary supports, which must carry the traffic during the replacement. The mere erection of entirely new structures, free from the incumbrance of moving traffic, is considered an easy job.

In October last, the contractors engaged in the erection of the bridge at Cairo swung free and clear a 520-ft. span in six days, and in November last the same parties erected the trusses of another span of 520 feet length in 44 hours, and more recently they erected a 400-ft. span in 31 hours, the wind blowing a gale nearly all the time.

The successful completion during the past year of the Hudson River cantilever bridge at Poughkeepsie reflects great credit upon the builders and engineers in charge, and the equally successful completion and skilfully conducted erection of the Hawksburg bridge in New South Wales adds new fame to the same firm of contractors, whose leading partners are all prominent members of this society.

Whether the limit of possibilities in bridge construction will be reached in the execution of Mr. GUSTAV LINDENTHAL'S design of a railroad suspension bridge over the Hudson river, with a span of 2,800 ft., resting upon towers 500 ft. high, and carrying, in addition to wagon-ways and foot-walks, six railroad tracks, at a height of 150 ft. above water; or whether the projected crossing of the British Channel will require still larger dimensions, are problems which may perhaps interest at some future day the younger members of this society.

The recent revival of the temporarily abandoned Hudson River tunnel project, and the proposed tunnel under the river at Detroit, are enterprises demanded by the necessities of continuous transportation lines for the through traffic of our railroads.

The efficiency attained under the admirable system of our modern railroad workshops is graphically illustrated by the recent erection of a locomotive in the Altoona shops of the Pennsylvania Railroad in 16 hours and 50 minutes. Photographic views were taken at intervals, showing that at 7 o'clock in the morning the bare skeleton frame and cylinder rested upon wooden blocks and screw jacks. At noon the fire box and boiler had been mounted. During the afternoon working hours the truck and wheels were placed in position, the pilot attached, and the cab erected. Work was stopped at 6 P. M. (18 o'clock) and resumed at 7 A. M. the next day, and at 2.50 P. M. the locomotive was completed and ready to start on its journey.

Aside from the important position which the railroads occupy in the commercial world, their beneficent influence upon the social relations of the community and their direct effect upon the advancement of civilization is universally admitted by all intelligent and right-minded men. The state of civilization of a country and the intellectual standard of its people are measured by the character of its national literature. If the same conditions apply to professional occupations, then the quality of our chosen pursuit, as it appeared half a century ago, was certainly not a very exalted one. At that time, there was scarcely a sign of original American engineering literature in existence.

Our text books were translations from foreign authors even down to the elementary primers; and the few professional standards and treatises on special subjects were either imported or reprinted. To-day the printing presses of our publishing houses are busy with the best productions of our native talent, and our professional periodicals are kept abundantly supplied with the current contributions of our brightest workers and deepest thinkers, while the selected transactions of our technical societies fill the bookcases of their members, and furnish them volumes of valuable reference. All combined marks the rapid march of our advancing civilization.

The condition of our society is gratifying and this growth continues upon an increasing scale. Its high character is constantly enhanced by the admission of new members prepared for their professional duties by a thoroughly scientific training in schools conducted by eminently qualified teachers.

The high educational standard now attained by the successful students of our leading technical schools, not only places them upon an equal footing with the other learned professions in social life and business intercourse, but the services of the practising engineer are at last beginning to command their merited reward.

The Manufacture of Sulphite Fibre or Pure Wood Cellulose.*

This sulphite fibre, or pure wood cellulose, supersedes rag-stock in paper making. The wood in chips is boiled in great digesters, with a solution of bi-sulphite of lime, and the main engineering lies in the design and construction of a suitable, economical, and lasting digester. The processes examined by the writer were the GRAHAM, MITSCHERLICH, PARTINGTON, RITTER-KELNER, and the SCHENCK.

The Mitscherlich digester is the largest of these, and it is 14 x 40 ft., while none of the others exceed 10 x 28 ft. He uses steam at 40 to 45 lbs., the others use it at 75 to 80 lbs. Prof. MITSCHERLICH claims that the slower boiling yields a better and surer output, and while he consumes more time (from 45 to 72 hours), he turns out from 10 to 14 tons at a time, as against 1½ to 3 tons by the other processes in 15 to 24 hours. The digester itself is in general made in cylindrical form, of open-hearth steel or iron-plate, by some inventors set horizontally and by others vertically; and they are all fixed except in the Partington and Graham processes, in which case they revolve. As the bi-sulphite solution has a great affinity for iron, the inside of all makes of digesters must be lined with a resistant, fluid-tight material; the materials used for this purpose in the various processes were deoxidized bronze in the Schenk process, lead lined in the Graham, Partington, and Ritter-Kellner process, and fire-brick lining in the Mitscherlich; the latter lining being of a special brick which are made of a German clay similar to that used in making the Nassau Seltzer jugs.

Capt. MICHAELIS then described in detail the various digesters here referred to, and particularly in the linings used, and the effect of long service upon this lining. The fire-brick lining laid in Portland cement proves to be following out the direct line of modern practice. The clay stands enormous stresses from heat, it has a coëfficient of expansion only about 40 per cent. of that of iron, and two years' use have failed to develop defects.

The bi-sulphite solution is manufactured by the vacuum, the modified tower, and the tower processes. The vacuum system is used in connection with the Partington, Schenck, and Graham patents, and the best plant examined cost about $6,000 complete. The modified tower system is used with the Ritter-Kelner process, and includes the pumping of the solution into a series of low towers, under cover, filled with limestone. The author did not notice any particular advantage in this method over the vacuum process. The Mitscherlich tower method is partially automatic, and is certainly the most economical. In it the sulphurous acid gas is drawn up into high towers, filled with limestone, by atmospheric draft, and therein meets water trickling through the filling. The consumption of sulphur varies from 200 lbs. per ton of fibre in the Mitscherlich patent, up to nearly 600 lbs. in the others. None of the others use less than 350 to 400 lbs.

In the mechanical preparation of the wood, all of the processes, except the Mitscherlich, use chips; this one exception is discs cut from the log and 1½ ins. deep. There is a waste of 10 per cent. in sawdust in cutting these discs, but Prof. MITSCHERLICH claims that the output is a better fibre than when chips are used. In the "cooking" of these chips or discs of wood, the "quick" and the "slow" processes are used, the terms applying to the time consumed. The quick process is not patented and requires a strong solution of the calcic bi-sulphite, a high pressure, a short time, and yields a small product. The slow process is the Mitscherlich patent, and demands a weak liquor, low pressure, and a long time, but yields from four to eight times greater product. The author thought the latter process was the most logical and precise. In this

* Abstract of paper read by Capt. O. E. MICHAELIS, U. S. A., at Annual Convention of Am. Soc. C. E., June 21, 1889.

Mitscherlich process the cooking is done by steam pipes, or indirect heat; in the others by direct heat, or the condensation of steam.

The author then pointed out the defects in the handling of the German process, and believed that, with American business management and engineering skill, the process can be much simplified, and the cost of output much reduced. The process is actually an American invention, taken up and made commercially effective by German improvements upon the method, and these can be again improved upon by Americans. A wide field for the creation of practically a new industry is here pointed out, one that will demand a supply of American engineers trained in its manipulations. The paper concluded with an outline of the chemistry of the sulphite-fibre industry.

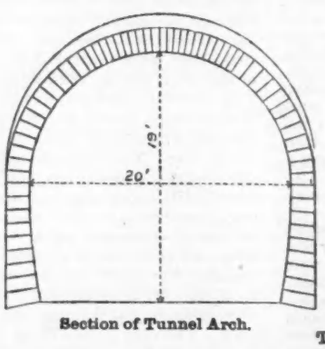
The First Railroad Tunnel in America.

We here illustrate from a photograph the Allegheny Portage tunnel referred to in our article of last week on the Johnstown disaster. From the interesting "Reminiscences" of the first railroad over the Allegheny mountain, read before the Pennsylvania Historical Society, by SOLOMON W. ROBERTS, C. E., we learn that this Portage road was commenced in 1831 and was opened as a public highway in 1834.

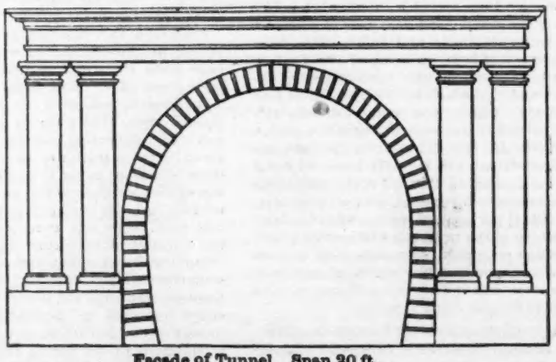
This tunnel was driven in 1831-32 through a spur of the Allegheny mountain at the Staple bend of the Conemaugh, four miles above Johnstown. Its length is 901 ft., span 20 ft., and the clear height is 19 ft. as shown in the cuts here reproduced from Mr. ROBERTS' publication. At each end a length of 150 ft. was arched with cut stone. It cost about $37,500 and is remarkable as being the first railroad tunnel in the United States. Although long abandoned as a line of traffic, the handsome proportions and substantial masonry of this tunnel bear witness to-day both of the good taste and thoroughness of its builders.

Incline No. 1 commenced at the end of this tunnel, and our general view shows in the foreground the remains of the pit of the hoisting engines used in this connection. Beyond the tunnel for some distance the old roadbed of the Portage road still remains, with its stone blocks in place, but of course minus the rails.

The First Railroad Tunnel in America; built in 1832, on the Allegheny Portage Railroad. (From a Photograph.)



Section of Tunnel Arch.



Facade of Tunnel. Span 20 ft.

The Portage Tunnel; built in 1832.

The American Engineers in Europe.

We have received from Prof. L. M. HAUPT, of the University of Pennsylvania, the following interesting notes of the trip to June 14 of those members of the American Society of Civil Engineers who are now abroad:

The visiting American engineers via S.S. *City of New York* arrived off Queenstown at 4.30 P. M., June 5 (ship's time), and while most of the party proceeded to Liverpool a few took the lighter for the Irish port. As the Whitsuntide holiday made it necessary to postpone the reception to be given in the Guildhall at London until the 13th inst., it was arranged that members could pass the time by selecting one of the three itineraries to interesting works in England and Wales. Your correspondent improved this interval by visiting the principal harbor of Ireland, and hence left the party at Queenstown, a natural harbor enclosed between two headlands and well fortified.

It was here that we gained our first experience of the British railway plant, and although it has been so frequently described, a few reflections thereon may be of service to our colleagues in the profession. The "way" at stations, is always sunken from 2 to 3 feet below the platforms, the ties are generally treated and spaced about 3 ft. apart; the rails are 67 lbs. T section, and generally in 21 ft lengths. The old form of cast-iron shoe or chair supports the rail at each tie. The joints are suspended and formed of a simple pair of fish-plates 16 ins. long, fastened with four bolts. The ballast is coarse gravel and the road bed firm.

As to the rolling stock, the vans are subdivided into from three to five compartments each containing two seats placed transversely: the first and second class upholstered, third not. The ventilation is secured by lowering the glass in the door by a strap, as in the old stage coach. The cars are lighted by lanterns inserted in sockets through the roof. These are withdrawn in the morning by a guard and handed down by means of a long pole held by an attendant on the ground. In passing through the frequent tunnels, there is no light in the train, and cases of assault are not infrequent. Only last week a murder and suicide occurred

There is supposed to be a cord passing along the top outer edge of the train, and while the pulleys for it are there, the cord itself is generally absent. The cars measure 7 ft. 7 ins. across, and each compartment will seat 10 persons, making from 30 to 50 to the van. As the three classes must be provided for, some of the vans are overcrowded while others are empty. The inability to pass through the train causes considerable delay, since all tickets must be examined, punched and collected by guards at the stations, and in this way the great advantage gained by having no grade crossings, and thus being able to make time, is virtually lost. No "conveniences" exist for passengers *en route*. The only apparent advantage of this form of carriage is the ability to empty a train quickly. The "rule of the road" is to the left both for railway and street traffic.

The start is made by the ringing of a hand bell; then a whistle from the guard, who waves a green flag, followed by blasts from the engine, and the train pulls out. Through the courtesy of a locomotive engineer from the Pacific Coast now visiting his fatherland, an opportunity was given to ride in the cab and note the special features of the passenger engine. The most important was a sliding door for the fire-box. It was so arranged that by moving a lever right or left the two halves of the disc covering the port could be opened or closed. When tightly closed, the smoke issuing from the stack was black and full of cinder from the soft coal used, but when partially opened to admit air over the grate, the comoustion was more complete. The cabs are of sheet-iron and all the working parts are within or beneath the engine, which had crank axles, although this is by no means the common form. The speed made between stations on a down grade was 65 miles per hour taken by stop watch.

There are frequent overhead crossings spanned by skew bridges built on Buck's system, or modifications thereof. Names of stations, sometimes paved with colored pebbles on the slopes, make an attractive feature.

The cars are warmed in winter by long pans filled with hot water and changed by the guards at stations. How well this works in practice we were not informed.

The station arrangements are complicated by having at least two sets of rooms for restaurants, waiting and "booking," one for first, the other for second and third class. As the roads almost invariably enter the cities on the "high level," a ramp or incline is often used instead of steps as being far safer.

The sleeper is arranged so that two compartments open into a transverse aisle. Each compartment contains two couches (no upper berth), a commode, racks and a lamp in the roof with a cap to screen the light. The door bolts on the inside, so it cannot be opened by the conductor or guard. For a family of more than two this must be a very unsatisfactory arrangement, especially where there are young children. At this rate the capacity of a car would be about 12, while for very little more dead load it could be doubled. There were no lavatories in the section.

At this writing your correspondent has visited Cork, Dublin, Belfast, Glasgow, Edinburgh, Newcastle-on-Tyne, Sunderland and London, and thus far has seen no pavements so poor or so dirty as those of our principal American cities. There are many having steep grades where tram-stones are laid for the brake-shoe to slide upon. Belgian is most frequent, though wood, asphalt and macadam are common. The tram-rails are a great improvement on our center and side-bearing rails. They are girders having a groove in the head which guides the flange of the wheel. There seemed to be but the one form in use. A cable was being laid in Edinboro' to overcome the steep gradients. The yoke is much lighter and simpler than those used in the United States. The trench between is made of concrete.

On June 7 and 8 a number of engineers visited the Manchester Ship Canal, and commenced with an examination of the great docks which will form the terminus at the Manchester end. They will have an area of 114 acres in water space and 152 acres of dock room. The London *Standard*, of June 10, well describes what was here seen, as follows:

The quays of five basins on the one side are being built in the ground, the walls being of concrete up to the fender course, which is of hard stone. Next comes several feet of blue-faced bricks, and then a coping of three feet of Welsh granite—a total height of 37 ft. These quays are 120 ft. in breadth, with water spaces of 150 ft between them. On the opposite side are three other ships' sidings of larger capacity. The first locks keep the water of this terminal section at its proper level. The contractors' work done in this section is already very large although it does not appear upon the surface. But it will not be long before the excavation of the earth between the waterways will show the extent of the progress already made.

As the journey along the contractors' railway was proceeded with, the gigantic character of the undertaking, and the energy with which it is being carried out, became more and more apparent. Enormous earth gashes have been made in every one of the ten sections into which the whole canal is divided. In the second section, there is an example of the capability of the extension of the canal for local purposes in the increase of its width to 170 ft. for a distance of three miles between Manchester and Barton, whereby a tier of shipping can be moored along wharves on the Salford side out of the way of the ordinary ship traffic proceeding along the canal. At Barton, where there are also locks and sluices, the course of the Ship canal is crossed by the Bridgewater canal. The height of this canal above the Ship canal not being sufficient to permit of the passage of masted vessels, its general continuity will be maintained by a swinging aqueduct. Ordinarily this aqueduct will be in position, and barges will pass along it without impediment, but for the passage of ships along the canal the ends of the aqueduct will be closed, and it will be then swung aside and replaced without any loss of water. About three miles further on, there is another set of locks at Irlam, which completes the third section of the ship canal. The fourth section is formed by the locks at Latchford, and thence past Warrington to its debouchure there is a clean run of level water.

The course of the canal from Manchester to Latchford is a constant succession of cuts across the sinuosities of the rivers Irwell and Mersey. The interferences of the Ship canal with five existing lines or railways was also one of the original engineering difficulties. This is to be overcome by raising the railway bridges to the clear height of 75 ft. above the canal. Some ships will still have to strike topmasts to pass under these bridges. At Warrington a large dock will be made at right angles to the canal. From Latchford the canal passes in a straight line to Runcorn. Thence the Ship canal makes a sharp bend to the left past Weston Point. From the Frodsham side of the Weaver, the Ship canal proceeds to the right to Eastham, where it will terminate in gigantic entrance locks. The railway sidings and roads into the various excavations—many already cut for miles in length and excavated almost to their full depth—exceed 200 miles in length. Gigantic steam navvies and other appliances for excavation are at work, and 15,000 men are employed. When completed, the Manchester Ship canal will be practically one long dock 35 miles in length, from the Cheshire side of the estuary of the Mersey.

Leaving the canal works, the party proceeded to Chester, and thence on the following morning were taken by special train over the extension line of the Manchester, Sheffield & Lincolnshire Railway to Connah's Quay, where they were received by Sir EDWARD WATKIN, and shown the new swing bridge over the Dee, the span covered by which is the longest, by 36 ft., over any navigable river in the United Kingdom. The width of the river at the crossing is 480 ft.; and the large swing opening will give a free passage of 140 ft. in width. The length of the swinging girder of the bridge is 287 ft., and the width at the center 32 ft. Two fixed spans of 120 ft. each, complete the crossing of the river. The swing bridge is wholly constructed of steel, the weight thus being only 850 tons. The pivot on which it works is a solid ball joint, and the ends of the lines of rails on the reclosing of the bridge after opening, are brought into exact contact automatically, so that the trains may safely run over the joints. Hydraulic power, at 700 lbs. pressure, is supplied for the working of the swing bridge, which may be opened or closed in 40 seconds. This bridge is, in connection with a short line, constructed to join the Cambrian railways at Ellesmere, and will form a new route from Swansea, Merthyr, and other large centers in South Wales, to the Mersey and to Manchester, as well as on to the Lancashire and Yorkshire and Northeastern districts.

THE VISIT OF AMERICAN ENGINEERS to England is thus outlined in *Engineering* of June 14: Last week 230 American engineers, accompanied by 50 ladies, landed in Liverpool, and commenced a series of visits which has been arranged for them by the Institution of Civil Engineers. On Thursday they made an inspection of the Liverpool docks, Messrs. Laird's works at Birkenhead, and the Mersey Tunnel, and in the evening attended a reception given in their honor by the mayor. On the following day the greater part of them traveled to Crewe, where they were entertained by the London & Northwestern Railway Company, and afterwards went over the works. Smaller parties went to the Midland Company's works at Derby and the Lancashire & Yorkshire Company's works at Horwich. In the evening all met in Manchester, where they were received by the mayors of that city and of Salford, Oldham, and Stocknort before dining in the City Hall.

From Saturday, June 8, to last Wednesday, the party dispersed themselves through England, visiting the lakes, North Wales, Derbyshire, Warwickshire, or whatever district attracted them, and assembled in London on Wednesday evening. Yesterday was a field day. At 10 A. M. the visitors attended choral service at Westminster Abbey; at 11 A. M. they met in Henry VII.'s chapel to hear an address from the dean, Dr. Bradley, on the sacred and historical associations of the Abbey; at noon they inspected the Houses of Parliament. A formal reception took place at 3 P. M. at the Institution of Civil Engineers, followed at 3.30 by the presentation of an address by the President, Sir JOHN GOODE, K. C. M. G.

In the evening there was a dinner at the Guildhall, kindly lent by the Lord Mayor for the occasion. Next Thursday, June 20, the American visitors leave for Paris, and in the meantime a very extensive programme of excursions has been arranged for them. To-day there are two alternative excursions down the river, and in addition most of the riverside works are open to inspection to those who do not care to undertake either complete trip. On Saturday a portion of the party will go to Windsor, while others will attend a performance of "Midsummer Night's Dream" in the grounds of Copped Hall, Totterridge. In the evening Lord BRASSEY will give a reception. On Sunday places will be reserved for the visitors in some of the leading churches and chapels. Monday will be devoted to seeing the palaces in London and to attending a garden party given by the Baroness Burdett-Coutts. On Tuesday there will be two excursions up the river, both ending at Hampton Court. Wednesday will be divided between the various railway warehouses in the city, the London and Southwark Subway, the London Electric Supply Corporation's works at Deptford, and the Flower Show in Regent's Park. In Paris an equally extended and attractive programme has been arranged.

The South Forks Dam Failure from an English Standpoint.

Writing to the *Times* on the Conemaugh dam, Mr. RUSSEL AITKEN says:—"It was a stone dam that gave way, and it seems to have been solidly built, for it is stated that the unbroken mass of masonry, when forced outwards, reared 30 ft. into the air, thus showing that it turned on its outer edge as on a hinge and fell into the valley. It is difficult to say what was the cause of the disaster, unless one saw the drawings and the nature of the work itself. It was not until 25 years ago that the late Mr. FROUDE showed how such structures should be calculated. The French engineers made elaborate calculations, but they discarded them when they came to do the work, and trusted more to the judgment of how the design looked when drawn out on paper. In fact, they trusted to their engineering instinct as to what would stand and what would not, and with one exception they were right. In 1869, when in India, I pointed out that the Poonah masonry reservoir dam calculation was founded on incorrect data, but here again the calculations were put on one side and the practical instinct used to make the dam strong enough; the mortar with which the masonry was built was not strong enough. When it was filled it was found that the dam had bent outwards ⅝ of an inch, so the dam has never been filled within 10 ft. of its intended high-water level."

Unfortunately for Mr. AITKEN'S theories, we must doubt his bottom facts. But we should be sorry also to live below a dam constructed in accordance with French "instinct" as here described.

A 48-IN. WATER MAIN WAS LOWERED lately as follows by Mr. DEXTER BRACKET, to the Boston Water Department: This main was 1,800 ft. long and had been previously raised from 0 to 18 ft. in 1886, as described in ENGINEERING NEWS of Jan. 23, 1886. In 1888 it became necessary to lower this same pipe a short distance, and to avoid the expense of the trestle work and lifting screws previously used, the expedient was adopted of excavating to the depth of the pipe over its whole length and then cutting across trench under each pipe. In this trench a blocking of 2-in. plank was set at the proposed lower grade and the earth was then excavated and the pipe allowed to slowly settle on the blocks. The pipe was not broken or emptied, and though the gates were closed at the ends as a precaution, Mr. BRACKETT thought that it might have been safely used during the lowering process. The time occupied in lowering 1,000 ft. and redriving joints was about 8 hours.

THE CAIRO BRIDGE across the Ohio will probably be ready for traffic before Dec. 31 next, the time set in the contract. The long approach is being pushed in the shape of a timber trestle, which is later to be filled in with earth.

CORRESPONDENCE.

Sounding Apparatus.

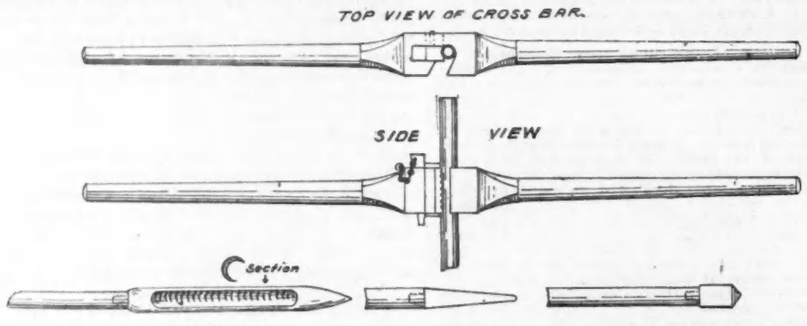
CITY OF CAMBRIDGE, Mass., June 4, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Seeing some inquiry and correspondence in regard to boring, sounding, etc., in your journal lately, I take the liberty of sending you the enclosed sketch of sounding-rod and cross-bar as designed by me last year, and in use at this office since then. It has given very good satisfaction.

The rod itself is of a seamless, cold-drawn, steel tubing, ¾-in. exterior diameter, ⅛-in. thick, in sections 8 ft. in length. The sections are joined by having one end plugged with a steel plug, with thread cut so as to screw into corresponding thread in end of the other sections. A smooth surface is thus presented throughout the whole length of the rod.

This tubing-rod I could only obtain of J. S. Long Sons & Co., of New York, and while it is somewhat expensive, it is well adapted for the purpose, being light, stiff, and



convenient for assistants to carry on cars and as required in city work.

The rod has three points, either one of which may be screwed to the end of the rod as shown,—one a blunt point for testing bottom, one a long point for going through crust, etc., and one with "pod" for bringing up samples of soil.

The cross-bar for working the rod is forged as shown. It is attached to the rod by means of a movable block of hardened steel, on one face of which (next to the rod) are cut teeth or threads, and which is set by a wedge attached to the bar with a small chain. The movable block is kept from falling out by a pin moving in a slot cut in the back of cross-bar.

When the bar is placed on the rod, a smart tap on the wedge from a wrench, hammer, or stone, sets the whole thing firmly together, and when through, a smart tap from below loosens it as readily. Yours,

L. M. HASTINGS, *City Engineer.*

"Dirt Maps."

CHARLESTON, W. VA., June 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Referring to the article in ENGINEERING NEWS of June 1, on "Making Dirt Maps," by the natives of Upper Burmah, and which characterizes that method as a "new diversion invented" by one of the Englishmen present, after being "struck with a bright idea," I would respectfully claim *priority* for this invention or bright idea, whichever it may be.

In 1853-4, the writer accompanied the expedition for the exploration of a route for a Pacific Railroad from the Mississippi to California along the 35th parallel, under the auspices of the War Department and commanded by the late Gen. A. W. WHIPPLE, then a lieutenant in U. S. Topographical Engr. Corps.

At Albuquerque, ANTOINE LEREVEUX, of Taos, an old trapper, was engaged as guide. It was the custom, after our expedition passed the San Francisco mountain, to organize small scouting parties from time to time, to explore ahead for a wagon road. We left "New Year's Spring," our camping place January 1, 1854, on the 2d or 3d, on our first scout, accompanied by pack mules in charge of DON MANUEL SEBASTIENO SAAVÆDRA, a pompous, ambitious New Mexican, who claimed to be of pure Castilian strain. LEREVEUX, Lieut. WHIPPLE, and myself were of the party. We "fetched a compass" around a considerable territory ahead of camp, occupying some en or twelve days.

On this first trip a friendly dispute arose as to the beeline to camp, some fifteen or twenty miles away by estimate, on the last day's march; LEREVEUX insisting on one course and I another, and Lieut. WHIPPLE inclined to LEREVEUX's opinion as being an old experienced *voyageur*. We dismounted for a parley, and the bright idea struck me, and I dropped on my knees and with my hands constructed a map *in relievo* with the sandy loam. There were two marked objects in front of us, two volcanic buttes several miles west of camp, between which we had passed, as I knew from having fixed them "in my mind's eye" by looking backward, on our journey out. Pointing to these, I insisted that our camp was in that direction, and referred to my dirt map. LEREVEUX shook his head contemptuously, and pointed to another butte much farther off, and in a different direction, and said good naturedly, "You d——n fool, camp is beyond yon butte some ten miles." The party started off under LEREVEUX's lead, and I with a companion flanked off in the true direction, and shortly reached the two buttes and our old trail. We signaled this fact, and the party changed course, and followed us. LEREVOUX was a little chopfallen at his mistake, for if we had followed his guidance our goal would have been missed widely, and as it was very cold, and we were on quarter rations, it would have been an uncomfortable night for us.

After this we frequently constructed dirt maps in discussing our inspection views on the "lay of the land"—then a *terra incognita*—we were exploring. Dirt maps you will perceive are an American invention.

This Don Manuel SEBASTIANO SAAVÆDRA was the occasion of the naming of the cañon Diabolo. It was in this wise.

We started at night on a bee-line from the Little Colorado river across the plain toward the south side of San Francisco mountain. The snow was falling in large feathery flakes, obscuring the view, and the moon gave brilliant light, illuminating the snow. The Don and myself were in advance of the train, he expatiating on the renown of the SAAVÆDRAS of old Spain, and after several hours' ride our mules came to a stand-still, and so suddenly as to come near pitching us over their heads; "Diabolo!" exclaimed the astonished Don as he discovered a yawning abyss before us. "That's the name of this cañon," remarked I, and noted it down for the map.

ALBERT H. CAMPBELL.

The Rainfall at Richmond.

RICHMOND, VA., June 10, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

The rain gauge which is kept at our shops, just outside of Richmond, gives the following record:

1872,	8.64	ins.	during	March, April and May.
73	14.48	"	"	"	"
74	12.38	"	"	"	"
75	11.38	"	"	"	"
76*	8.59	"	"	"	"
77	8.54	"	"	"	"
78	10.95	"	"	"	"
79	7.23	"	"	"	"
1880	7.83	"	"	"	"
81	7.93	"	"	"	"
82	8.60	"	"	"	"
83	10.16	"	"	"	"
84	8.51	"	"	"	"
85	9.16	"	"	"	"
86	16.03	"	"	"	"
87	8.79	"	"	"	"
88	12.88	"	"	"	"
1889	24.55	"	"	"	"

The average precipitation for the whole period is 10.92 ins.; for 1889, 24.55 ins., during this period the spring rainfall of 1889 exceeded the average about 125 per cent., and was 8.52 ins. more than any previous record for 17 years. Before the recent disastrous storm, it had nearly doubled the average, and that downpour was 4.15 ins. in about 36 hours; culminating in 2.85 ins. in about 7 hours. That a deluge resulted is not surprising.

Very truly yours.

E. T. D. MYERS, *Gen. Supt.*

[The storm was in every respect a phenomenal one, as these records clearly bring out. We trust it will be thoroughly reviewed by the Signal Service for the benefit of engineers and the public generally.]

Carbonized Cement Pipe.

MILWAUKEE, Wis., June 10, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Can you or any of your readers inform me regarding the durability of cement pipe "that has been carbonized in tight kilns from six to twelve days"—a process now used by the makers of such pipe?

Would not the pipe be better and more durable if it were *not* carbonized in this manner? Is not the process of induration, present and future, arrested by corbonization in kilns? It appears quite reasonable that if cement pipe when freshly made is put into a kiln, and heated from six to twelve days, it must come out an inert substance, in which all future chemical action is dead and future induration of the pipe impossible. To me the process suggests the baking of bread, or dough, before it has risen.

The white efflorescence which appears on all good concrete, masonry, and brickwork shows the chemical action which the mass is undergoing in the work of induration; this efflorescence I have not seen on carbonized cement pipe, hence the doubt of any benefit derived from its carbonization.

MUNICIPAL.

[We must leave this question to be answered by the experience of users of carbonized cement pipe. The point raised is whether the action of heat combined with certain gases, and applied during six or twelve days, does or does not leave the pipe in as hard a state as if it had been buried in moist earth for the same number of years.—ED. ENG. NEWS.]

The Cambria Co. Geological Survey Map.

Pennsylvania R. R. Office,
PHILADELPHIA, June 19, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In the last issue of your paper you say that the Geological Survey of Pennsylvania have never issued a map of Cambria County. I desire to correct you in this, and herewith enclose you a map issued by them and printed on white paper especially for us, and in return for information we furnished them.

This map, along the line of the Pennsylvania R. R., is based, and in fact copied, from a fine topographical map in our possession made in 1850 of the whole region embraced in the Conemaugh Valley, and on the eastern slope of the mountains down to Altoona and Hollidaysburg. I regret that I did not send you this map when I wrote to you last. It has never been colored, but the dotted lines show the outcrop of the coal.

I am not sure that this map has been issued publicly; I think perhaps it has not, and in that respect your statement is correct. Yours truly,

SAM'L REA.

[We take it all back, as far as the existence of the map is concerned, for the one sent is an excellent map, and for it we return our thanks. We would have been glad to have had it sooner, but as the map we published agrees with it in every particular, no harm is done. We made our statement on the authority of the official list of *published* maps of the Pennsylvania Geological Survey.—ED. ENG. NEWS.]

Causes of Low Joints; Correction.

BOSTON, Mass., May 31, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of the 11th inst. which has just overtaken me here, you have reproduced a cut of rail, from *Stahl und Eisen*, of May, 1886, which is a reproduction of a cut on my track inspection diagrams, to illustrate how rails, very low at the joints, were injured by passing trains. The cut, first published on the diagrams of 1882, has since been used for illustration until 1887. A large number of engineers from abroad have sent for diagrams, and the cut has been obtained from some of them. I send by this mail diagrams containing the cut, viz. No. 6. I would call your attention to cut No. 1, from the Baltimore & Ohio R. R. condensed diagrams for 1888, illustrating a rail which was low at the joints a few years since, but, by a much higher standard of track, the "cutting out" has been largely checked. They use a joint tie but a short angle bar, and from their high standard of track obtain excellent results. Cut No. 7 is a representation of many of these rails after 5 years of service. There is some wear of the angle plates, but as long as the deflection of the joints is only about ⅛ in. in 10 ft., the rail ends do not cut out much faster than the other portions of the rails. If the track is not maintained up to a high standard, I have found the joints to become low with the three-tie angle; but the rate is not as fast as with the suspended angle bar. Yours truly,

P. H. DUDLEY.

[We now recall that the admirable illustration of the effects of bad joints to which Mr. DUDLEY refers did appear first in some of his diagrams, and we owe him an apology for having credited it to *Stahl und Eisen*, where we found it. The interesting diagrams which he forwards with his letter are separately reproduced.—ED. ENG. NEWS.]

The Largest Artificial Reservoir in the United States.

CUBA, N. Y., June 17, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Please inform your readers what is the largest artificial lake in the United States. People here claim the old canal reservoir here to be the largest. Is it true?

Respectfully

A SUBSCRIBER.

[As to the Cuba reservoir, a correspondent of the Albany *Evening Post* says that the plans on file in the State Engineer's office show a flooded area of 605 acres, not 1,200 and 2,000 acres as commonly reported in the daily press. As built in 1851 this dam was 51.5 ft. high with a flooded area of 400 acres, but it was raised in 1868-71 to 65 ft., and its area would of course be increased probably to the dimensions above given. As to the other great artificial reservoirs, we cannot positively say which one is the largest in the United States. The largest ones are probably on the Pacific coast. The Caleveras reservoir has a dam 183 ft. high with a capacity of 30,351 million gallons; and a moderate estimate would give this reservoir an area of over 1,200 acres. The Walnut Grove reservoir in Arizona covers 1,000 acres; it has a dam 110 ft. high, and the Cochituate lake, on the Boston, Mass., water-works, has an area of 800 acres. The Croton lake on the New York supply covers 400 acres. If any of our readers know of greater artificial reservoirs of water, we would be glad to hear from them.—ED. ENG. NEWS.]

Notes, Queries and Answers.

UNDERGROUND SURVEYING.—A correspondent in Helena, Mont., asks for the *best* treatise on underground surveying. We can give a list of books on the subject; we should like to know from experienced mining engineers which book they consider the *best*. Prompt information is requested.

A CLAY PUDDLER, of 500 cu. yds. capacity per day, is inquired for by a correspondent, and also the address of firms manufacturing such puddlers. We must confess we do not know of any such puddlers, and send the query out among our readers in the hope that it may catch the eye of some one better informed.

NOTE.—We have received from Mr. CHAS. A. STOES a letter replying to that of Gen. Supt. ABBOTT, of the Canadian Pacific Railway, which appeared in our issue of June 8, Mr. ABBOTT'S letter having been in reply to an earlier one of Mr. STOES. As the question under discussion is merely a personal one, in regard to which we have now published one statement on each side, we cannot give space to any further discussion of the matter, and cannot attempt to give the matter such further consideration as to either form or express any opinion other than that we have already expressed. We may state that Mr. STOES in his later communication adheres to the substance of his former one; and we will only add further that the C. P. R. snow sheds and glance fences are a sufficiently great success to warrant distributing a considerable share of credit among a number of persons.

Light and Heat by the Decomposition of Water by Electricity.

In an article on water-gas and its applications, by MAX GEITEL, published in a recent number of *Glaser's Annalen*, is a short historical notice on the decomposition of water by means of electricity, which is condensed as follows:

When a galvanic current is passed through water, hydrogen is liberated at the negative pole, and oxygen at the positive pole, and in the proportion of 1 to 2. This method of obtaining hydrogen, first tried by NICHOLSON and CARLISLE, in the year 1800, has been often attempted since, but without real success, by GILLARD in 1849, and H. M. PAINE, of Worcester, Mass., in 1850. In 1860-61 the method of the Belgian Abbi NOLET for obtaining illuminating gas, based on the electrical decomposition of water, created quite a sensation in Paris, where it was brought forward by one SHEPPARD.

The essential part of the process, which was kept secret, was said to consist in a certain preparation which was able to modify the water to be decomposed in such a manner that the gas developed could be non-explosive. The gas was said, according to an analysis by HOLMES, to contain 12 parts oxygen and 82 parts hydrogen.

MOIGNO, who in his *Cosmos* mentioned a prospectus published by SHEPPARD in the *Literary Gazette*, remarked that the secret must simply be that a substance is added to the water which seizes upon the oxygen as it is released by the action of the electric current. What is produced is then hydrogen, which is combined with carbon and then burned. In this gas there is a very small proportion of oxygen, $\frac{1}{4}$ part by weight, $\frac{1}{12}$ part by volume, so that an explosion cannot take place.

MOIGNO found his conjectures verified when present at an exhibition of this so-called "electric gas," and wrote about it as follows:

"The facts are exactly as we had conjectured. The apparatus is an electro-magnetic machine provided with 7 induction coils; the water to be decomposed is contained in 7 small glass flasks, in which the electrodes lead from these flasks to a single tube through which the gas flows, to be collected in a gasometer. The whole secret consists in this, that there is added to the water a substance as yet unknown, which absorbs (to a great extent) the oxygen as it is liberated, and at the same time facilitates the decomposition of the water, so that the gasometer contains principally only hydrogen gas, which is carburretted by a suitable hydrocarbon, The odd feature of the experiment consists in the fact that the power of a man can in a given time produce as much carburretted hydrogen gas as is necessary for supplying 7 ordinary burners during the same space of time. This is certainly very interesting; but to the supplanting of coal gas by the so-called 'electric gas' is an immense stride."

The matter came, moreover, to the notice of the Emperor NAPOLEON III, and experiments were made in his presence. 1,000 cu. ft. of this gas were said to cost 12 cts.; the secret preparation cost per 1,000 cu. ft. gas, 4 cts. But this "electric gas" was soon forgotten.

The article closes by stating that this extended notice of the production of hydrogen by electrolysis of water is given in the hope that scientists may see in it a means for the production of light and heat, and that, with our great advance of the last few years in electric science, it may contain possibilities now even undreamed of.

Elements of Weather in the United States of most interest to Engineers, for the month of May, 1889.

STATIONS.	Temperature. Degrees Fah.				Wind velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average.	Max.	Direction at time of Max. Vel.	Total.	Heaviest in 24 hours.	No. rainy days
NORTHERN CITIES.										
Northfield, Vt	56.9	90	31	59	6.7	45	N	2.48	1.65	10
Portland, Me	54.8	92	37	55	7.4	25	W	2.65	1.43	9
New York City	60.0	87	40	47	7.4	35	NW	3.25	0.91	11
Pittsburg, Pa	61.6	90	37	53	5.0	23	W	6.45	2.96	14
Chicago, Ill	54.7	88	36	52	13.1	48	N	5.59	1.42	14
Omaha, Neb	61.6	90	37	53	9.9	40	S	2.67	1.12	11
St. Paul, Minn	55.4	84	33	51	7.6	38	SE	2.86	1.26	10
Duluth, Minn	48.9	78	32	46	6.8	30	NE	2.05	0.79	13
Bismarck, Dak	52.4	81	22	59	10.2	42	S	3.35	1.33	13
Average	56.3	86.7	33.9	52.8	8.2	36.2		3.46	1.43	11.7
SOUTHERN CITIES.										
Washington City	64.0	93	39	54	7.0	50	NW	10.69	2.98	17
Louisville, Ky	63.4	90	37	53	6.1	31	W	5.26	2.99	14
St. Louis, Mo	62.8	90	42	48	11.7	38	S & N	3.80	0.94	11
Savannah, Ga	71.4	96	50	46	6.2	25	W	0.35	0.25	4
Leavenworth, Kan	62.8	89	37	52	8.5	36	S	9.90	2.51	15
Jacksonville, Fla	72.7	94	50	44	5.7	24	W & S	0.51	0.36	3
Chattanooga, Tenn	65.2	91	41	50	5.2	30	NW & W	4.59	2.75	10
New Orleans, La	73.8	90	54	36	8.0	24	SW & NW	1.17	0.42	5
Memphis, Tenn	68.2	90	47	43	6.4	30	NW	1.48	1.18	9
Palestine, Tex	70.8	88	48	40	6.7	40	W	3.47	2.44	7
Average	67.5	91.1	44.5	46.6	7.2	32.8		4.12	1.68	9.5
WESTERN CITIES.										
Helena, Mont	52.8	80	31	49	6.0	36	NW	2.20	0.78	12
Port Angeles, Wash	Not yet received.									
San Francisco, Cal	56.8	88	48	40	10.0	32	W	2.17	1.29	11
Salt Lake City, Utah	59.8	87	34	53	6.6	36	S & SE	2.97	1.06	7
Denver, Col	54.0	83	32	51	6.2	45	NW	3.44	2.08	12
Yuma, Ariz	77.0	107	50	57	8.1	42	W	0	0	0
Santa Fé, N. Mex	56.7	80	32	48	8.8	37	W	0.15	0.13	4
Average	59.5	87.5	37.8	49.7	7.6	38.0		1.82	0.89	7.7

THE WEEMS ELECTRO AUTOMATIC TRANSIT CO., of Baltimore, Md., has issued a statement of which the following is an abstract: The company was organized on Feb. 13, 1888, for the purpose of developing a system of transporting mails, express matter, etc., by an electric railway running at great speed, as patented by Mr. DAVID G. WEEMS. An experimental line, covering a circuit of two miles, has been constructed at Laurel Station, B. & O. R. R. On this line there are 29 changes of grade, and one about 108 ft. per mile. The motor car run on this track is 2½ ft. square and 18 ft long, wedge-shaped in front with the point of the wedge below the axis of the car to assist in holding the car to the rail, at high speed. All wheels and electrical appliances are placed within the car to reduce atmospheric friction. The road is 24 ins. gauge, and is estimated to cost $5,000 per mile. It would be elevated as a rule.

The motive power is electricity supplied to three Sprague motors, aggregating 60 H. P., in the leading car through the medium of a third rail of copper above the line of cars. The first trial for speed made showed one mile per minute. The report states that "with important improvements added through more recent experiments we expect to make a speed of from four to five miles a minute on a commercial line." Two miles per minute are said to have been made. JULIAN J. CHISOLM is president, and Mr. WEEMS is the general manager of the company.

THE CONNECTICUT GRADE CROSSINGS number 1,215, as before mentioned in this journal, and the estimated cost of removing them is $20,638,627, or an average of about $17,000 each, though one crossing in Hartford will require an expenditure of at least $300,000. As there are 1,013 miles of railway in the State, owned by ten different companies, the proposed bill only requires a change in about 13 crossings per annum, and at this rate 100 years will be required to eliminate all the present grade crossings in the State. This may be called a beginning, but it is slow.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

THE press of matter from the various engineering conventions must be our apology for cutting down our illustrated matter this week, and also for deferring until our next issue the continuation of the report on railway wheels and rails by the committee of the American Society of Civil Engineers and considerable correspondence.

As noted in our news columns last week, a somewhat curious correspondence has taken place between Consulting Engineer CHURCH and the Construction Committee of the new Croton Aqueduct Board. Both sides of the correspondence may fairly be said to be curious. The committee on its part resolved that "the work yet to be done consists in the main in making provision for a plentiful supply of water," to run through the new aqueduct tunnel, which is now substantially completed, "involving the location of reservoirs and the construction of extensive dams for restraining the natural flow of water," and that *therefore* the services of a consulting engineer were no longer required. Mr. CHURCH, on his part, objects to both the committee's preamble and the committee's conclusions and states, "with all respect for the committee, but under a sense of public duty," and with evident force and truth, "that the preamble (above quoted) states the strongest possible grounds for continuing the office of consulting engineer." If the services of a consulting engineer were ever desirable and useful, they are certainly likely to be as useful in the delicate work which remains to be done as in the simple if gigantic work of driving a 30-mile tunnel. Mr. CHURCH, however, does not confine his argument to the impersonal one of whether or not a consulting engineer is as desirable now as ever, as to which he is on impregnable ground, but he adds that the above quoted preamble states also the strongest possible grounds for "continuing with it (the office) the services of one who has long made a special study of this part of the problem, which still remains undetermined," i. e., himself.

To this rather delicate, but under conceivable circumstances which may now exist, personal plea, Mr. CHURCH adds the following strictly technical plea, which, we think, it will be the general opinion of engineers, comes at least from the wrong source, and unless there are others in a wholly disinterested position who are prepared to support it, might better have been omitted:

> I am also compelled, by a profound sense of public duty, before expressing an opinion on the time and manner of the proposed change, to question the propriety and legality of such change, based upon a vote of the committee or commission in which your own vote is necessary to constitute a majority.
>
> I am advised that, inasmuch as you, General, are a regularly commissioned officer in the service and pay of the United States, you are ineligible to fill the position or lawfully exercise the power of an aqueduct commissioner. This being so would invalidate the action of the Committee of Construction in regard to the resolution proposing the abolition of the office of consulting engineer. I would not, of course, question a majority vote, of which there was no legal doubt.

WE are disposed to sympathize with all efforts of engineers to keep their office out of politics, and to prevent politicians or others from ousting them therefrom for other than adequate reasons. Such conduct may easily spring from "a profound sense of public duty," even when the impulse to it is also stimulated by a certain personal interest. But Gen. DUANE is not a politician, and he cannot rationally be supposed to be acting from any political motive. He is the last man in the world likely to be so actuated. He is an engineer officer who has served with distinction, and has all his life kept apart *ex officio* from politicians and political ways. Whatever may be the error of his views in regard to this particular question, he is *prima facie*, from his training, one of the most conspicuously fit men on the Board for the appointment he holds. He has taken and so far held the office, if we do not err, without any objection being raised to his acting therein, either by Mr. CHURCH or others, and the inference is strong that there is now no disinterested person ready to father and present the claim, or he would surely have been chosen to do so, rather than to have had the claim presented by Mr. CHURCH himself, at a time when his judgment was so evidently likely to be biased.

We cannot, therefore, believe that there is much in the legal point, now made by the Corporation Counsel in support of Mr. CHURCH, although neither our nor any engineer's judgment on so fine a point is entitled to much weight; but in any case, we regret to see an engineer, who fills a distinguished position and has had a distinguished professional career, taking a view of public duty that leads him to raise such a point in his own behalf. In holding up to ridicule as untenable the alleged motives for abolishing the office of Consulting Engineer, Mr. CHURCH stands on impregnable ground. It were far better if the fight were made on this issue, and the Commission compelled to advance some other and better reason, or to change their purpose. Resort to a weak technicality, as to which any engineer's opinion is worth little, seems rather *infra dig.* professionally, with the further disadvantage that it is not likely to prove effective, but rather to create greater irritation. If the Aqueduct Commission, or any other such Commission, really wish to make a change, they will accomplish their purpose, even if defeated for the moment. If they do not really wish to make the change, if their purpose is not really a settled one, why take steps that must inevitably result in strengthening and confirming the purpose? All engineers will do well to bear these facts in mind when placed, as all are liable to be, in similar positions.

The opinion of the corporation counsel that Gen. DUANE is not lawfully an Aqueduct Commissioner because he was holding a Federal office at the time he was appointed does not seem to agree with the facts. Gen. DUANE ceased to be Chief of Engineers in the U. S. Army on June 30, 1888, and was then retired from service by reason of his age having reached the limit prescribed by statute. He was appointed an Aqueduct Commissioner by Mayor HEWITT on Aug. 1, 1888, one month after his retirement from the Federal service; and, with all due respect to the legal opinion given, it would seem to us quite as proper to debar every pensioned soldier from a similar service as to question the present rights of Gen. DUANE. He holds no Federal office now, and did not at the time of his appointment; the retired pay he receives is actually a pension earned by faithful service under the Government for a prescribed term of years, and the very fact that he has served these years severs his connection with the army and creates a vacancy in his grade. Under the ruling of the corporation counsel here given, every official act of Gen. JOHN NEWTON, as Commissioner of Public Works, was also questionable, for he was likewise a retired officer of like grade with Gen. DUANE. The present strong opposition to General DUANE base their hopes on a decision of Chief Justice MILLER in the case of TYLER vs. the United States., in which it was held that as a retired officer still drew the pay and wore the uniform of the army and was still subject to the rules and articles of war, he must, therefore, be still held to be a part of the army. The act of 1888, constituting the present Commission, only intended to except such offices as were likely to interfere with the duties of a Commissioner and General DUANE's very slight connection with the military service can certainly not interfere. But as this matter is now involved in politics, we fear that common sense interpretations of the law will have little weight with men who want an office to fill.

IN view of the proposed expenditure of millions in repaving portions of this city, the advice of Mayor GRANT, that the subway company should lay all their conduits before the new pavement is laid, is good and sound. The one thing to be regretted is that the same advice cannot be made to apply to other underground appliances as well. Steam heating pipes, down town, and the pipes of new and old gas companies up town, are more troublesome even than electric wire conduits in continual breaking of the street surface; though the time that will elapse before the rather flimsily constructed electric conduits will enter upon their "age of tinkering" is still a matter of serious doubt. The new pavement is badly needed, and there is hardly time now to properly discuss the question of substantially built and adequate subways before proceeding to spend the $3,000,000 lately appropriated. But it is not too late to commence investigating the proper method to be followed before another appropriation is due. Present practice is frightfully extravagant, and its continuance means a never-ending series of appropriations, with little or no permanent improvement on the present condition of our streets. Engineers, better than any other class of citizens, appreciate the fact, that permanent relief in this direction means an "extravagant" outlay of cash on the part of the city, and that perfect relief means practically a thorough ripping-out of the entire system of sewers and pipes and conduits of all classes that now so thickly underly the business portion of our city, and their rearrangement on some systematic, all-embracing plan. Of course, this would cost a vast sum of money; but the work so done would be for genera-

tions, and not for very short periods only, as is the effect of present practice. Once well done, the annual saving in paving and repairs on a well-laid street surface would pay good interest on the original investment, to say nothing of the increase in comfort, convenience, and better sanitary conditions to all the citizens of this vast metropolis. Proper subways, carrying sewers, water and gas mains, electric wires, etc., must come some day, and now is the time to formulate plans and find out how it could best be done and what it will cost. If the multitude of their daily duties will prevent the engineers now in the city's employ from devoting to this end the proper amount of time, let a commission be appointed of the most experienced engineers the land can supply. The latter is certainly the best plan in this case; for the work will require the highest order of engineering talent, and to pluck order from prevailing chaos will demand long experience and the most careful study. It is a task that will, in its preliminary study, require a large expenditure of both time and money, but it is worth all that will cost, and it cannot be commenced too soon. Until well-digested plans and estimates of cost are available, it is idle to discuss the matter at all; but with these data at hand, we firmly believe that common wisdom and a proper regard for the expenditure of public money would very soon lead to a radical reform, simply as a matter of better economy and an increased regard for the comfort of the public.

THE Chicago & Alton Railroad Company has given notice that it will withdraw from membership in the Interstate Railway Association on July 15. The company was at first reluctant to join the Association, and has recently made complaint that it was being seriously injured by the unlawful competition of other members of the Association. It has disagreed with the Wabash over passenger traffic between Chicago & Kansas City. It has petitioned to be allowed to reduce its lumber rates to meet the competition of Northwestern roads. It has accused the Chicago, Milwaukee & St. Paul of stealing its live-stock traffic by secret cut rates, and though the St. Paul company has affirmed its intention to abide by the decision of the Board of Arbitrators of the Association, and turn over to the Alton Company all but two train loads per week of its live-stock traffic, the Alton declares that the cut rates still continue and that it gets no more traffic than before.

Whether the charge of the Alton against its various competitors is true or false, the fact is evident that the company's managers are loth to be bound by the restrictions of traffic associations of any sort, and are anxious to push the war of competition to the bitter end, and let the fittest survive. In the present state of affairs in the West, the adoption of such a policy by a company of the Alton's importance and influence may lead to the gravest results. If the other companies succeed in keeping their organization intact, and are forced to compete with the Alton on Missouri river rates, the inevitable result will be the disruption of rates all through the Southwest. If, on the other hand, the Association fails to maintain its organization, the result will of course be far worse. Strong pressure will doubtless be brought upon the Alton managers to induce them to reconsider their action; but unless the company's heaviest stockholders make some move, which is not likely, the withdrawal will probably be adhered to.

Should this season witness a repetition of last season's railway war, perhaps in an aggravated form, the results in the stoppage of new construction and permanent improvements, the forced paring down of operating expenses, and the reduction in the forces employed and the wages paid, will seriously affect railway interests of every class. The action of the Alton must be deeply and universally regretted.

NOT more than two or three months ago Mayor GRANT, of this city, very properly refused a concession of land at Battery Park for the better working of the Manhattan elevated system, though few or no surface privileges were to be interfered with; and at that time he put himself upon record as inalterably opposed to any curtailment of the city's parks. Yet he now as earnestly advocates the blocking up of the more important City Hall Park by a new municipal building six or eight stories high and covering about one and one-quarter acres of grass plot. This is not consistent. If an elevated structure would deprive citizens of park privileges and obstruct their light and general traffic, this high building will certainly be more objectionable from a similar standpoint. We want the new buildings badly, and other sites already built upon would answer quite as well. But to locate them upon the park is to destroy forever just that much more air space in an already curtailed area. Parks are too scarce in lower New York to permit of their confiscation by either private corporations or city authorities, and the "comfort and privileges" of the public, that were used as an argument against the one, should be quite as valid in the present case. There is no sentiment about this thing, for the park has other parts to play than that of giving shelter and rest to the "weary workman or footsore tramp," humane as both of these uses may be. It rests the eye, and is an undefinable but actual comfort to every one who passes it, and is just that much of mother earth in our busy city that still retains a semblance of its native covering and is free from brick and mortar. It is well called "a breathing spot," and such it should remain, despite the arguments of Mayor GRANT and his friends. The true value of what is left of the City Hall Park cannot be measured in dollars, and it is faulty public policy to build here simply to save the expenditure of dollars on another site that should more properly be secured, and so utilized that it would rather add somewhat to our elbow room and city adornment, than to take from the little we have remaining.

THE excellent paper of the Hon. WM. J. MCALPINE, elsewhere printed in this issue, is an especially timely contribution, coming as it does when the daily press of the country is filled with nonsense concerning the security of "dirt dams" as a type. Mr. MCALPINE clearly shows, what every engineer who has studied the subject properly already knows, that correctly designed, honestly built, and well maintained earthen dams are under certain circumstances the safest of all structures for impounding water; and that the destruction at South Fork was due to causes altogether outside of the fact that the dam was built of earth. The one lesson of real value to be learned from the disaster in the Conemaugh valley is the extreme importance of having all such structures, whether of earth, wood, or masonry, at once carefully examined by competent men, wherever these dams now exist. And such examination should be coupled with legal powers to compel repairs where such repairs would make the structure perfectly safe, or to drain the reservoir and cut the dam where its original design is so faulty as to be beyond repair, if any such dams really exist, or if long neglect has left them in this condition. The present public concern for the general safety of dams, while in most cases groundless, is a healthy sign of an awakening interest in a matter too long neglected; and if the public can be kept awake long enough to rouse up our legislatures to the importance of formulating really effective laws bearing upon the proper design, construction, and care of dams in general, the lives sacrificed at Johnstown will not have been sacrificed altogether in vain.

THE prospectus of the Congo Company for its proposed African railway is a wide departure from similar documents, particularly in its methods of fixing rates. Prospective receipts and profits are figured on the basis of present traffic with men as carriers, and it is estimated that the minimum gross receipts must equal the amount now paid for transporting freight and passengers through the cataract region. In other words, a ton of freight will cost $200, and one passenger $100, or 38 cts. per mile, for the distance covered by this road. It is evident that there is little fear of competition, and commerce will be made to pay for the advantages of civilization. But, on the other hand, commerce pays no more for the greater advantages, and without these provisions the road could not be made self-supporting. It is a development plan, and about the only one adapted to the conditions.

Discussions at the Master Mechanics' Convention.

Another pleasant and successful convention of the American Railway Master Mechanics' Association has come and gone, and left the members refreshed, it is to be hoped, by their brief vacation from duty, and perhaps equipped with some new ideas to put into practice during the coming year.

The subjects discussed at the meeting just closed were none of them, perhaps, of transcendent importance; yet in another view of the case there is hardly a detail of construction under our Master Mechanics' direction, in the last analysis, that is not intimately concerned with safety as well as with economy is, and in that view of the case, no detail can be considered trivial.

The scheme which the Association has adopted, of having committees appointed one year previous to the meeting on each of the subjects for discussion, seems in this case to work very well; and the reports of most of the committees contained matter of much value. This was especially the case where their efforts to obtain information by means of circular letters had been in some degree successful.

If one may judge by the tone of the discussions, however, these committee reports are hardly appreciated at their proper worth by the members. It is always difficult for a man of mature age and long experience to accept new statements and principles conflicting with his long established opinions, so it is not at all strange that this should be true. Most of the reports did of necessity recommend changes in ordinary practice, but the ideas they contain are on that account especially valuable, provided it is clearly shown that these changes are in the line of progress.

The variation between the tone of the committee's report and that of the discussion upon it was especially noticeable in the case of driving and engine truck boxes. The committee, Messrs. BUCHANAN, CLOUD, and BOON,

are men whose experience and position entitles their recommendations to respect. They reported in favor of a solid box of composition metal (bronze or brass). In the discussion, the report of the committee was largely ignored, and the members confined themselves to discussing the merits and demerits of the common cast-iron box with the "half moon" brass, the hexagon brass, or the three and five gib brass, while now and then some would allude to the friendless cast steel box. Certainly, however, the discussion showed that these old types of driving box are giving far from universal satisfaction. But little was said in the discussion in opposition to the solid composition box. Probably the real reason why many members were loth to commend its use is that, in the present condition of railway finances, driving boxes of solid bronze might be regarded as too expensive a luxury. But that this is a short-sighted sort of economy the following extract from the committee's report ought to show:

> The thought of the cost of the bronze or brass over cast-iron may at first be startling, but it is likely to prove economical when it is taken into consideration that the patterns can be made lighter than for cast-iron, the slotting out for bearing and fitting of same saved, the planing, boring and fitting will cost no more than cast-iron, and the box will wear until worn through at the top, or so light as to be unsafe, the loss from wear of bearing will be no greater, and there will be a saving of tightening up old and fitting new bearings.
>
> When the box is finally worn out, the credit for scrap will make a considerable reduction on cost of new box. The objection might be urged that in case of a hot journal the box might be ruined; extreme cases like this rarely occur.

But the committee could have put the case even stronger. The fact is that the chief cost of the bronze box is the material, and this, once purchased, can be used over and over again. The real cost of the box, therefore, over the iron box is only the interest, 4 or 5 per cent. on the first cost, and figuring on this basis it is easily seen how the real expense of the box will bear comparison with that of a cast-iron box. Another point not touched upon by the committee is the prospect for a reduction in prices of copper. Last year the price of that metal was kept up to 16 and 17 cents by the French copper syndicate. This year prices are down to 12 and 13 cents, and prospects are that it will go lower.

Doubtless much of the trouble with composition boxes which has sometimes been experienced has been due to the use of an alloy wrongly proportioned or improperly handled. Well-made gun-metal bronze is one of the toughest and most durable metals used in engineering. But carelessness in handling, the use of an impure metal, or a slight error in proportioning may greatly impair the value of the product.

One of the most important subjects taken up by the convention was that of driver-brakes According to the report, the Westinghouse and American Brake companies have supplied about 11,300 sets of driver brakes. The Eames company stated that its apparatus was in use on 364 different roads and the Beals company has 55 sets in use. Now, estimating from the figures in "Poor's Manual," there are about 30,000 locomotives in use in the United States, and making all allowances each way (for the Le Chatelier brake, number of brakes worn out, etc.) it seems pretty certain that not over half the locomotives in the United States are equipped with brakes. Consider first the question of economy only. It was pretty conclusively shown that with some of the styles of tire dressing brake-shoes now in use, the mileage which a locomotive could run before she would have to go to shop to have her tires turned down was increased by a large percentage over engines not so equipped. But an engine does not have to stay in the shop a very long time to have the loss of her service, the cost of tire turning, etc., eat up the interest on first cost and the cost of maintenance on a set of brake equipment, to say nothing of the fact that with most roads the loss of the engine's services amounts to considerably more than merely the interest on her cost while she lies idle.

It is thus seen that, from motives of direct economy alone, the use of driver brakes should become universal, and the secondary economy, which comes through the additional safety of trains so equipped, is great enough to set all doubts aside.

The report of the committee on the closely related subject of tires hardly presents sufficient data to determine whether a thick or a thin tire is the cheaper in the long run. And their conclusion in favor of a 3-inch tire will hardly change many opinions already settled. With their conclusion that for an engine tire the very best quality of steel is in the long run the most economical, every one must generally agree.

Four of the committee reports referred to the boiler and its details. The question of double-riveting the mud ring can be trusted to take care of itself, especially with the rapid introduction of engines with fire boxes above the frames; for not many men are going to mend frequent leaks in that awkward spot without taking some means of preventing them. The matter of a better boiler covering than the old wood lagging is a subject which should properly be agitated. It is indeed true that in proportion to the amount of steam generated, the locomotive boiler probably loses as little from external radiation as any type of boiler, even the stationary boilers protected by brickwork, Nevertheless there is a very large loss of heat which it is possible to avoid; and it seems very probable that the newer forms of non-combustible and non-conducting protection will effect economy enough to well repay their increased first cost.

The questions of increased water space around the heating surface and of the proportions of grate and flue area, especially the former, were very well handled by the committees who had them in charge. Their recommendation that the water space should be widened seems to meet with general approbation, and it is to be hoped that the reduction of grate area will not be allowed to stand in the way. It is almost a pity, however, that the closely related matter of circulation plates was not within the direct scope of the committee's inquiry and was only referred to by them.

The work attempted by the committee on the proportions of grate and flue area was most excellent: but the very meagre replies received to their circular (owing, doubtless, to the fact that few master mechanics have such records of the performance of their boilers as to be able to answer the question) prevent their report from definitely settling any question. Enough data were given, however, to point with considerable emphasis to the economy of intense combustion on a small grate surface,—a fact which is still too little understood.

We have referred to the fact that too little attention is paid to the reports of these committees. It is supposed that the practice of reading the printed papers at the convention is designed to call the attention to them of all the members of the convention. But if this be so, it largely fails of its object. The reform urged by several members, that the printed reports be read only by title, would give much more time for discussion and would make the meetings more interesting. If it were possible to issue the printed reports of committees a fortnight before the convention, it would give members a chance to study the reports in which they were interested, to discuss them and collect new facts before their departure, and they would come into the convention "cocked and primed" to support their view of the case. It was urged as a fatal objection to this plan that when reports are issued in this way, they find their way into print beforethe convention meets. But this seems to be a benefit rather than an injury. The more widely the conclusions of these committees and the subjects discussed are made known, the greater will be the interest felt in them. This, however, is a minor point. The main fact is that a thoroughly good technical paper is not nearly so interesting as a lively personal discussion of the same subject, and it is to give room for more of the latter that the former ought to be pinned down.

Gould's Specifications for Dams and Reservoirs.

By a mere coincidence, which we trust may lead to fortunate results to all concerned, we follow the record of the most fearful of all dam disasters by an advertisement, in another column, of the publication of a form of contract and specifications for the building of dams and reservoirs, which, if followed, would go far to prevent such awful occurrences. They have been prepared by Mr. E. SHERMAN GOULD, M. Am. Soc. C. E. Consulting Engineer of the Scranton Gas and Water Co. and formerly Assistant Engineer, Department of Public Works, New York City, and are published by us in his behalf. We may add, however, that they are not merely a set of specifications. A form of proposal, and a complete contract, printed with the proper blank spaces, is also provided, so that, for a large class of hydraulic work, the specification can be used, just as it stands, for proposals and contract as well, by merely filling out the blanks for the letting of work. This will not only save a great deal of labor in writing and transcribing, but also avoid clerical errors and secure uniformity.

The form of these papers is the same, with a few necessary changes, as that used by Mr. GOULD in the letting and building of the large storage reservoirs which he is now constructing for the Scranton Gas and Water Co. at Dunnings, Pa., one of which is already completed and filled. The class of dam directly contemplated by the specifications is of the very generally used type (the dam which has just failed was of this type) which consists of a masonry center wall and spillway and an earthen embankment, such as is fully described in Mr. GOULD'S revised edition of Jacob's "Storage Reservoirs;" * but by modifications they can be used for other types.

As no other specifications for this kind of work are in press, it is hoped that the publication of a set which has been already successfully acted upon may prove of timely use to the builders of water-works. As regards the legal forms and agreements adopted, those embraced in the standard forms used by the Department of Public Works of the city of New York have been closely followed, being considered among the best and most carefully prepared models extant; so modified, however, as to render them more applicable to general use.

* "The Designing and Construction of Storage Reservoirs," by Arthur Jacob, B. A. Revised and extended by E. Sherman Gould. Van Nostrand's Science Series, No. 6. Price 50 cts.

The San Diego Flume.

The great San Diego flume, recently completed, is described from a popular and commercial rather than an engineering standpoint in the *Golden Era*, San Diego, Cal. From this article the following general statements can be gleaned concerning this work: A company was organized on May 27, 1886, to bring water from the high mountains east of San Diego to supply the urgent demands of a domestic supply and to irrigate the rich valley and tablelands around this city. The credit of the original conception of this scheme is given to Mr. T. S. VAN DYKE.

The head of the system is in the Cuyamaca mountains, nearly 5,000 ft. above the sea. Here a reservoir is formed by a dam 35 ft. high and 720 ft. long, impounding about 3,740 million galls. of water and covering 900 acres. From the reservoir the water passes down a rocky ravine about 12 miles to the San Diego river, and just below this point of juncture with the river is a dam of solid masonry diverting the stream into the flume through regulating gates. This dam is 400 ft. long and 35 ft. high, and cost $36,000. Behind this dam is another lake of considerable dimensions.

From the head-gates to the reservoir, 8 miles from the city of San Diego and 630 ft. above the city, is a distance of 35¾ miles. This is the length of the flume proper. This flume is 6 ft. wide and 4 ft. high and is built of clear redwood plank 2 ins. thick. At present but one tier of side planks is used, making the height 16 ins. The full capacity of this flume is 5,000 miner's ins. daily, or 65,000,000 galls., a quantity sufficient to irrigate 100,000 acres. The trestle work on this flume line is very substantially built, and the Los Coches trestle, one of the largest, is 65 ft. high in the deepest part of the valley and 1,774 ft. long; the Sweetwater trestle is 81 ft. high and 1,264 ft. long, and many others assume very considerable proportions. The total number of trestles is 315. The gradient throughout is 4 ft. 9 in. per mile. In addition to the trestles a number of tunnels had to be driven, 6 ft. square, or arched where the rock was bad. The longest tunnels are: Laukersheim, 1,900 ft.; Los Coches, 313 ft.; El Monte, 290 ft.; Cape Horn, 700 ft.; South Fork, 200 ft.; Anderton, 270 ft.; and Sand creek 430 ft. long.

Besides supplying the city of San Diego, through the distribution system of the Coronado Water Co., this water is to be utilized for irrigation purposes, the surplus supply being sufficient for 40,000 acres. The present water-shed under control is set down at 150 sq. miles, and other storage reservoirs will be constructed as the need arises. One of these sites, near the La Mesa tract owned by the company, will impound 760,000,000 galls. of water, and the other has a capacity of 1,250,000,000 galls. The San Diego Flume Co. as originally organized had the rights of Van Dyke & Robinson transferred to Messrs. A. W. HAWLEY, G. F. JUDSON, T. S. VAN DYKE, GEO. D. COPELAND, W. E. ROBINSON, and W. H. SOMERS. The vice-president and manager, who immediately supervised the work, was Mr. W. H. FERRY, and L. F. DOOLITTLE is the Secretary.

The Pœtsch Freezing Process at the Houssa Colliery in Belgium.

From an abstract made for the Institution of Civil Engineers of an article in the *Bulletin de la Société de l'Industrie Minerale*, Vol. II. p. 21, we learn the following concerning the late sinking of shaft No. 8 of the Houssa colliery in Belgium, by the Pœtsch freezing process. This shaft was 13 ft. in clear diameter and had been sunk and lined in the ordinary way to a depth of 195 ft. At this point the bottom burst up, and gave vent to a very wet quicksand, which rose about 20 ft. in the shaft, and finally brought the water to within 82 ft. of the top. Soundings showed that, including the 20 ft. in the shaft, a stratum of quicksand 62 ft. thick had to be pierced before reaching solid ground.

By the advice of Mr. PŒTSCH, the shaft was plugged with solid concrete resting on the sand, and above this it was chambered out about 3 ft. on all sides. In this annular space about the shaft proper 18 6-in. freezing tubes were sunk about 10 ft. into the carboniferous strata below. The inner tube was 2 ins. and the connection made for circulating the freezing mixture in the usual manner. No attempt was made to keep out the water during the freezing, though the upper ends of the pipes were carefully lagged to prevent the absorption of heat. Owing to the inefficiency of the freezing apparatus, it was fully one year from 1886 before sinking could be resumed.

A shaft 11 ft. square was finally sunk through the cement plug and the frozen quicksand down to the solid. This was done by three gangs of four men each working in six-hour shifts. But the hardness of the material was so great that the sinking only averaged 18 ins. per day, as all the work was done by pick and drill. No blasting was permitted through fear of breaking the freezing tubes and shattering the frozen casing around the shaft, which had an estimated thickness of 10 ft. An attempt to thaw out the core by a steam-jet was soon abandoned, as it was cumbrous and hard to work, and produced a soft mud into which the workmen sank to their knees. Work was actually retarded by it. The artificial rock was so firm that timbers and scaffolding were safely carried on brackets carved out of the frozen ground itself.

At a depth of 255 ft. the square shaft was enlarged for the reception of three curbs, one of wood and two of iron, from which an inner lining of cast iron, 13 ft. in clear diameter, and 1⅝ ins. thick, was carried up and backed by 10 ins. of concrete. Ordinary cement was found to set perfectly, as the freezing had no injurious effect upon it. An admixture of sea salt was tried, but found to be unnecessary.

The freezing was done on the Carré principle, with a solution of ammoniacal salt of 29° Baumé, a density of 0.88, and a strength of 36 per cent., used under a pressure of 10 atmospheres. The liquid circulating in the freezing tubes was a solution of chloride of calcium of 21° Baumé, containing 23 per cent. of anhydrous chloride of calcium, congealing at + 7° Fahr. The degree of cold of the return current was + 14° Fahr., that of the frozen ground, + 18° Fahr., and that of the air at the bottom of the shaft, warmed by the lamps and the breath of the workmen, was + 31° Fahr.

PERSONAL.

MR. J. S. DUNNING has been appointed City Engineer of Aurora, Ill.

Mr. G. W. DENCH, Superintendent of the Central Ontario, has resigned. Mr. ROBERT FRASER succeeds him.

Mr. S. B. ADAMS has been appointed Division Superintendent of the Pullman Palace Car Co., with headquarters at Indianapolis.

Mr. C. W. SMITH, late Vice-President of the Atchison, Topeka & Santa Fé, is to be the General Manager of the Toledo, St. Louis & Kansas City Ry.

Mr. G. M. BEACH, late General Manager of the Cleveland, Columbus, Cincinnati & Indianapolis road, has been appointed General Manager of the Chicago & Atlantic, with headquarters at Chicago.

Mr. GEORGE W. MCNULTY, M. Am. Soc. C. E., has been appointed one of the Trustees of the Brooklyn Bridge. Mr. MCNULTY was one of the engineers in the original construction of the bridge.

Mr. GEORGE C. SMITH, who has been secretary to S. H. H. CLARK, First Vice-President of the Missouri Pacific Railway Co., has been promoted to be Assistant to the First Vice-President. He has been in the service of the Missouri Pacific system since 1881.

Mr. H. COLLBRAN, of the Colorado Midland, has been appointed Assistant General Manager in addition to his duties as Traffic Manager. The office of Assistant General Manager will be at Colorado Springs and the traffic office will remain at Denver.

Mr. ALBERT FINK, Chairman of the Executive Committee of the Trunk Lines Association, has resigned on account of ill health. The resignation takes effect July 10.

Mr. R. MARBLE, City Engineer of Columbus, O., has been appointed by the mayor for another year, and the appointment was unanimously confirmed by council.

THE NICARAGUA CANAL STOCKHOLDERS, at their annual meeting in Denver, Col., elected the following directors for the ensuing year:

A. O. CHENEY, H. C. TAYLOR, A. P. CHENEY, B. STURGIS, E. HOLBROOK, J. W. MILLER, A. T. HEDGES, A. S. HOYT, K. A. LANCASTER, J. P. SHAUGHNESSY, W. L. SCOTT, and DANIEL JEFFERS.

MR. JAMES HOWELL has been reëlected President of the Board of Trustees for the Brooklyn Bridge with $5,000 salary.

Messrs. WHEELER & PARKS, Civil Engineers, of Boston, Mass., have removed to an office in the Fiske Building, 89 State St., Boston. Mr. JOHN H. CHAPMAN, Architect, is in the same office.

Mr. J. T. HARRAHAN, General Manager of the Chesapeake & Ohio, is reported as having his territory extended to include the Consolidated Cleveland, Columbus, Cincinnati & Indianapolis and Cincinnati, Indianapolis, St. Louis & Chicago roads.

JOHN LATROBE BATEMAN, one of the old school of English engineers, died June 10. Mr. BATEMAN, F. R. S. S. L., F. R. G. S., F. G. S. and D. L., etc., was born in 1810 near Halifax, England, and commenced the practice of civil engineering in Manchester in 1833. He was especially famous in connection with water-works construction, the most important being the Loch Katrine works for the supply of Glasgow and the Longdendale works for Manchester. He was also the engineer of the water supply and sewerage of Buenos Ayres, Consulting Engineer to the Clyde Navigation Trust, for the large graving dock at Halifax, N. S., and a multitude of other important engineering improvements.

JOHN QUINCY ADAMS, ASA FRENCH, and HOSEA KINGMAN were appointed on June 26, by Gov. AMES, of Massachusetts, Metropolitan Sewerage Commissioners, with a salary of $3,000 each. All of these men are lawyers, and it is reported, that the civil engineer was intentionally left out of the commission, because it was feared that the presence of an expert in the board would be likely to produce friction, by an indeavor to force his own plans upon his fellow members. To which the answer might be made, that these plans would doubtless, be better than any formulated by lawyers, as far as the purpose of the commission is concerned.

GEO. H. CAMPBELL, of Boston, was appointed a Railroad Commissioner by Gov. AMES, of Massachusetts, on June 26. He succeeds EVERETT A. STEVENS, who was appointed by Gov. BUTLER, in 1883, and stepped into office from the foot-board of a locomotive.

PUBLICATIONS RECEIVED.

—*The Thomson-Houston Electric Railway System.*—Thomson-Houston Electric Co., Boston, Mass.

This is an interesting and nicely got up illustrated pamphlet, of 78 pp, relating to the electric railway system of this company. There are several photographic reproductions of views on different lines, and among other illustrations is one of a double-story car for Washington, D. C.; this type of car, although exclusively used in Europe, has not been adopted to any extent in this country, as the weight is so hard on the horses, but with electric traction they can easily be used and are very desirable during the summer. Descriptions of the system and particulars of the different lines are given, and the pamphlet is very interesting in character and appearance.

—*The Stevens Indicator.* Stevens Institute of Technology, Hoboken, N. J., April, 1889.

The April number of the "Indicator" contains the following papers: "Electric Railway Power Test," "Locomotive and Car Springs," "Friction of a Small Vertical Steam Engine," "Momentum of Steam," "A Model Electrical Manufactory," "Inspection of Riveted Bridge Work," "Cause of 'Black Paste' in Engines," "Features of English Locomotive Practice," "The Ferry-Boat *Bergen*," "Overhauling of a Mechanical Power."

—*Selected Papers of the Civil Engineers' Club of the University of Illinois.* No. 3, 1888-89.

CONTENTS: "Rapid Computation," C. L. CRABBS; "Sewage Disposal," J. B. TSCHARNER; "Speed of Locomotives," E. M. BENSON; "Strains in a Masonry Arch," Prof. I. O. BAKER; "Modern Improvements in Railroads," J. F. CLARKSON; "The Manufacture of Iron," F. J. TRESISE; "Track Problems," Prof. A. N. TALBOT; "Wood, Asphalt, and Stone Pavements," R. J. COOKE; "Brick Pavement," "C. H. SNYDER; "U-Abutment, Turnouts, Strength of Mortar in Masonry," H. DUNAWAY; "Experiments on Brick," Prof. I. O. BAKER.

This is a very creditable series of papers, especially when it is considered that they are mainly the work of students who have yet to learn by practice that side of their profession which practice alone will teach. The paper on "Wood, Stone, and Asphalt Pavements," by Mr. COOKE, is to be commended as presenting, in a condensed, and what may be called a popular form, a great deal of useful information regarding street paving.

—*The Official Railway List.* A complete directory of the officers of railways in North America, and handbook of useful information for railway men. Eighth annual number, 5¼ x 4¼ ins., 295 pp. neatly bound in cloth. The Railway Purchasing Agent Co., Chicago, Publishers; price $2.00.

This is a very handsome and neatly printed volume of especially convenient shape for pocket use. We shall be better able to judge as to its accuracy after using it for

reference for a few months, and though we were so unfortunate as to find that the very first road we had occasion to look up, the Kansas City & Southern Railway of Missouri, 111 miles in length, had been omitted, we do not judge that omissions of such importance are at all common. The making of an accurate railway directory is a work of infinite labor. The untangling of the snarl of corporate relations so as to give every official only under the name of the road over which his responsibilities extend; and, hardly less important, the deciphering of handwriting only less legible than the hieroglyphics of the mound builders, in order that every man may have his name spelled in the same way that he inherited it, is a work which would tax the resources of a Philadelphia lawyer. We forbear much criticism, therefore, on this book, and would only suggest that without some more ready means of reference from the general list of names to the alphabetical list of roads, the former is of little value, while the giving of the mileage and rolling stock after the name of each road is a most commendable feature which no railway directory should omit.

—*Pocket Reference Book of the Union Switch and Signal Co., Swissdale, Pa.*

This is a reference book of interlocking and signaling devices, and parts connected therewith, as manufactured by the above company. The book is substantially a treatise on this subject with a great profusion of illustrations and clearly expressed descriptive matter. The number and the variety of appliances in use for insuring the safety of the travelling public, and made by the Union Co., can best be realized by a study of this reference book. It is a very useful production.

—*Report on the Sewerage and Sewage Disposal of Revere, Mass.* By FRANK L. FULLER, C. E. May, 1889.

The disposal proposed is by water at a point about 1,000 ft. beyond the outer end of the Great Ocean Pier. The district to be drained contains 972 houses and the water consumption in 1888 was 88 000,000 galls., with a maximum for the month of August of 11,350,000 galls. The sewage is to be received in a collecting basin 100 x 31 ft., and holding 224,000 galls., and pumped to the point of discharge by an 8-in. centrifugal pump of 15 H. P. lifting the sewage 25 ft. The estimated cost of the system to be at once built is $166,000, including pipe system, basin, pumping station and main discharge. The consulting engineer was WM. E. MCCLINTOCK, C. E.

—*The Construction and Use of the Universal Hand Lathe* made by the Brown & Sharpe Mf'g. Co., Providence, R. I.

A treatise on the special make of hand lathe of this company and a clear and well illustrated description of the processes possible with it. Some of these processes are new to the majority of machinists and are taken from the shop practice of the Brown & Sharpe Co.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The convention of 1889 was held at the Octagon House, Seabright, N. J., beginning June 20. The place was well chosen for the pleasure and comfort of the members and guests, and especially so on account of the facilities it offered for the business part of the convention. When held in cities, there are so many things to see and do that the actual business is largely neglected, and the convention is mainly a social gathering with a technical flavor. When held at such places as the Catskills or Seabright, the members are located close to the meeting rooms, and there being few objects of special engineering interest to be examined or visited, there is more inducement to attend the meetings and discuss the subjects presented. There is also more sociability at such places, and the convention at Seabright was especially noticeable and pleasureable in this respect. A Committee on Introductions would, however, add considerably to the general comfort of newer members.

A large number of those present went down from New York by the Sandy Hook route, and had an opportunity of examining the steamship *Monmouth*, one of the finest boats on the bay and of her class. She is propelled by twin screws, driven by a pair of triple expansion engines, and her fitting and furnishing is of the most elaborate character.

A brief preliminary meeting for organization was held on the evening of June 20. President M. J. BECKER opened the meeting, and Mr. CHARLES MACDONALD nominated Mr. J. J. R. CROES as chairman of the meetings of the convention. Mr. CROES, on taking the chair, made a few remarks in which he referred to the advantages likely to be derived, from a business point of view, from holding the convention at a place where there were few engineering attractions of special interest to draw attention away from or cause absence from the meetings.

On Friday, June 21, the first regular meeting was opened with reasonable promptness, and the first business was the reading of a very valuable and interesting paper by Mr. THEODORE COOPER, on "American Railroad Bridges." The paper was lengthy and mainly historical, beginning with the old Charles River bridge at Cambridge, Mass., built in 1660, and tracing the progress down to the present day. [We shall fully abstract this paper later.] He paid tribute to the skill of TIMOTHY PALMER, of Newburyport, Mass., who, although little known as an engineer, did considerable work in bridge construction, including a bridge over the Schuylkill, at Philadelphia, Pa., in 1804-05. Mr. COOPER emphasized the fact that in designing we must calculate for a train load and not for a uniform load; the engines will always be heavier than the cars they have to haul, and even if there was the same load on the cars, the wheels are never so close together as those of locomotives. He referred to the three principal types of bridges, viz., plate girders, lattice girders, and pin-connected spans. In speaking of bridge failures, he stated that he did not know of a single case of a modern, all wrought-iron American railway bridge having failed under legitimate train service. On the same point he stated that such failures have no more bearing upon the relative merits of the different systems of their construction, than the failures in other kinds of machines. He thought that while the competitive system in this country, guided by a general specification, is more apt to produce good bridges than dependence upon designs prepared by any one with limited practical knowledge, its best results follow when supplemented by the independent judgment of the practical bridge engineer. Mr. COOPER'S views in favor of pin-connected bridges as against lattice bridges are well known, and, after the historical portion of his paper, he proceeded to explain his views as to the advantages and merits of the former system.

Major MICHAELIS referred to the military bridge building work done during the war, and suggested that Mr. COOPER should look up the records of this work and include this branch in his paper. He referred particularly to the work done by Col. W. W. WRIGHT, Chief Bridge Builder for Gen. SHERMAN, during his great march through Georgia. In reply to this, Mr. COOPER stated that he had thought of and tried this, but had been able to obtain but little information, as records of this kind of work were not kept to any extent during the busy times of the war, and Mr. STAUFFER, who had tried to procure such information for him, had not met with much success. Mr. SEAMAN referred to the paper presented at the Convention of 1885, by Mr. JAS. L. WILSON, which has resulted in a general improvement of bridge specifications, and stated also that he did not think the term "fatigue of metal" unscientific or absurd, as has been claimed.

Mr. GEO. H. THOMSON, referring to the statement by Mr. COOPER that lattice railway bridges exceeding 180 ft. span were not in existence in this country, mentioned two spans of 260 ft. each, as actually now and for some time past in existence at Bellows Falls, Vt.; also other spans of 193, 216, and 220 ft.; he also stated that on the New York Central, for 17 years past, there was about 1,700 lin. ft. of such bridges exceeding 180 ft. span. Lattice bridges are built by a very large number of works, and there is a growing feeling in favor of this type of construction. Mr. HOYT stated that the advocates of the lattice bridge did not claim it to be cheap for long spans but to be safer in case of derailment than the pin-connected structure. He had had experience of derailments on both types, and thought a good pin-connected bridge equal to a riveted lattice in such case. Mr. COOPER, in referring to Mr. THOMSON'S correction, stated that, in some instances, he had had great difficulty in obtaining information, and that he would be glad to receive any corrections, that his paper may be revised and corrected before it goes into the Society's Transactions in complete and final shape. Mr. WATKINS, Curator of the Transportation Department of the National Museum at Washington, referred to the attempt now being made to start a collection of matter in regard to the history of American bridges, and asked for material for such a collection. There was comparatively little discussion on this paper of Mr. COOPER'S, owing to the fact that this would have required considerable time for study, and the late mailing of the "advance copies" prevented this.

The paper on "Timber Trestle Bridges for Railways," by Mr. ONWARD BATES, was not presented, the author being absent and not having had time to complete it. A brief paper with the same title, by Mr. C. PALMER, Engineer of Bridges and Buildings, Chicago & Northwestern Ry., was read. He thought sufficient attention had not been paid to the designing of trestles, and pointed out that in the South and West especially they constitute the majority, in some localities from three-quarters to seven-eighths, of all the railway structures. Much technical skill is not required to design an ordinary trestle, but good judgment is necessary, and in high trestles there is room for the exercise of good construction faculty. He referred to the difficulty the practical bridge builder very often has in getting the purchasing department of the road to supply timber of proper quality. The structures should be of ample strength; the stringers especially should be as rigid as possible, and should be composed of at least two members. He favored short bolsters under the stringers; ties 6 ins. apart in the clear, with guard rails notched on them. In high bents the outside posts should batter 2¼ or 3 ins. per foot, and for lateral solidity should be stayed every 16 ft. with 3 x 10-in. transverse and longitudinal girts. He disapproved of mortise and tenon work, and thought this practice now almost obsolete.

There was no discussion on this paper, which is to be regretted, as the timber trestle (as already shown) is an important feature in American railway structures, and an exchange of opinions and descriptions of different practice would have been of interest and value. Mr. PALMER'S paper, however, had been presented as a discussion of Mr. BATES' paper, although complete in itself, and no advance copies had been printed.

The next paper read was one on "Componential Trusses for Traveling Cranes," by Mr. H. B. SEAMAN. The paper described two trusses of 87 ft. 7 ins. span, c. to c. of columns, built for special circumstances where an ordinary deck girder could not be used on account of the necessity of leaving a headway underneath for railway trains. The vertical load was resolved into two components, horizontal and oblique, and these components were each carried by a separate web system. These web systems were united at their apex by a common chord, and the remaining chords were united by a vertical system. The truss had therefore the cross-section of a right-angled triangle, having three chords and three webs, the rail stringers being carried on the outer bottom chord. Mr. COLLINGWOOD suggested that, as the arrangement was so novel, the author would increase the value of his paper by going more into detail, and Mr. SEAMAN promised to do this before the paper is printed in the transactions.

At the afternoon session, the first paper read was on "The Sibley Bridge," by O. CHANUTE, W. H. BREITHAUPT and JOHN F. WALLACE. This bridge was built in 1887 at Sibley, Mo., to carry the Chicago extension of the Atchison, Topeka & Santa Fé R. R. across the river. There are 3 channel spans of 400 ft., shorter shore spans and a long iron trestle approach. This paper, as well as the one not read on "The Van Buren Bridge," by C. D. PURDON, shows the growing tendency of engineers to publish descriptions of their works to enable other members of the profession to profit by their experience. Mr. COOPER, in his remarks in connection with his paper on bridges, had referred to the advantages derived by the practice of European engineering publications in publishing full descriptions of important bridge works, and the advantages of publishing details of such work will be readily recognized by readers of the two important bridge papers referred to.

The next paper was one by Major MICHAELIS on "Lime Sulphite Fibre Manufacture in the United States." Mr. MICHAELIS has recently had occasion to investigate the different processes in use for the manufacture of sulphite fibre or pure wood cellulose, to be used instead of rag pulp in paper manufacture, and he gave descriptions of these processes. He stated that, in his opinion, the subject was a promising one, and of commercial importance, predicting a great future for this industry. The methods are in use in Europe, and imported German labor has been employed in this country, but he thought that Americans would improve upon the processes and use native labor. [We publish elsewhere an abstract of this paper.]

Following this came a very interesting historical paper on "The Development of the American Rail and Track," by Mr. J. E. WATKINS. He referred to the intimate connection between coal, iron, and the railway in the early days when the increased demand for coal turned attention to devising improved means of transportation. On a wooden railway in existence at Newcastle, England, in 1672, one horse could haul 8 or 9 tons of coal. The first metal rails were of iron, cast in plates 3 or 4 ft. long, 2 or 3 ins. wide, and 1-2 or 3-4 in. thick. Models of old types of rails, including the fish-bellied, edge and pear-shaped rails (one of the former of which had a bevel joint with pin fastening passing through chair and rail ends), were exhibited, and descriptions given in order of date of other early forms of rails: there were also actual sections of the old Portage Railway rail, strap rails, the Strickland bridge rail, a Camden and Amboy T rail 7 ins. high (1849), and many interesting drawings. The strap rails were about 2 1-2 x 5-8 in., often with hand-drilled holes for spikes. Particular attention was given to the historical series of rails tried on the old Camden and Amboy Railway. Only strap rails could be rolled by our rolling mills for several years after 1825, and roads using edge rails had to import them from England. Mr. ROBERT L. STEVENS, President and Chief Engineer of the Camden & Amboy road, while on a voyage to England, designed the first base rail, his object being to avoid the use of the expensive "chairs" used with the English system of track. At first it was proposed to make the base wider at the supports. In 1836 the track of this road was very similar to our modern track, except that the fish-plates were straight bars, but in 1857, cast-iron angle splices, with 4 bolts were in use. The compound rail, as used on the New York Central, was described, and the author suggested that it had given good results and might be the rail of the future. In 1867 the first steel rails were rolled to order by the Cambria Iron Co. He called attention to the fact that, until the appointment of the Society's Committee on Wheels and Rails, rail sec-

tions had been designed by one set of men and wheel flanges by another set, without any reference to each other's work. The first rail mill erected in this country was at Mt. Savage, Md., and the first rails were rolled in 1844; they were bridge rails, 42 lbs. per yd., and were laid on the Baltimore & Ohio. Mr. WATKINS stated in conclusion that he had preferred to confine himself to a description of such rails as are represented by original sections, models, or drawings on the section of Transportation and Engineering, in the U. S. National Museum, but it is to be hoped that he will elaborate and extend it before it is printed in the Transactions, and we would suggest that any engineers or others, having drawings or data in regard to these matters, present them to the collection of the museum, or at least give Mr. WATKINS access to them in order to enlarge and extend his paper. Even as it stands, the paper is a most valuable addition to the historical literature of American railways.

In the evening the annual address was delivered by the President of the Society, Mr. MAX J. BECKER. This address was a summarized review of the progress of engineering in its different branches, and we abstract it fully elsewhere.

On Saturday, June 22, the morning session was called to order promptly at 10 o'clock. Mr. GEO. W. RAFTER made some notes on his paper on "The Fresh Water Algæ and their Relation to the Purity of Public Water Supplies," which paper had already been read at a regular meeting of the Society and was published in abstract in ENGINEERING NEWS of May 11, 1889. The subject was then open for discussion. Mr. CROES outlined the general scope of the subject, showing how, at certain seasons, water supplies are subject to "diseases," the reasons of which are yet obscure; but which reasons may be made apparent by investigations which have been made and which are now being continued on an increasing scale. Mr. WORTHEN, in a humorous speech, which combined humor with valuable information, gave his experience with vegetable and animal growths at different places; he did not think these growths injurious to health, but even if they were, "what are you going to do about it"? You cannot freeze or filter them out, or get rid of them by disinfecting. He approved of the circulation of the water and of the treatment of a reservoir as a large aquarium. The water should not stagnate, as stagnation causes the death of the animalculæ, and this death causes the smell and odor; the water should not remain in the reservoir more than two days. He thought the purity of the Croton supply to be largely due to the small size of Croton lake. Mr. FRANCIS thought that circulation was fundamental in efforts to maintain water supply in good condition.

Mr. F. B. STEARNS, Engineer of the Massachusetts State Board of Health, gave an interesting discussion in regard to the quality of water supply and presented diagrams showing the varying amounts of albumenoid ammonia contained in the water of two systems for three years, showing an apparent regular variation of quality at different seasons. Similar diagrams plotted from analyses made in 1876-77 had given practically similar results. He referred to the important work now being done by the State Board of Health in the investigation of water supplies, experiments on sewage disposal, etc. There are employed 3 engineers, 6 chemists, and 2 biologists. Mr. BRUSH gave in substance his discussion of this paper at the time it was first read, referring to his experience at Hoboken, where very considerable trouble had been felt, and where he had obtained excellent and satisfactory results by aerating the water. He did not believe in trying to kill or remove all animal life from the water, but approved of maintaining a balance between animal and vegetable growth, and has stocked his reservoir with carp and black bass. Water should not be filtered unless it is to be used at once. Rivers undergo a purging process every year, and the same natural process goes on in reservoirs, etc.

Mr. WHINERY described the system of aeration in use in the West in connection with separate cisterns. The cisterns are covered, but that does not prevent the formation of algæ, and an aerating pump is used which resembles an ordinary chain pump, but instead of plain discs there are little vessels or reversed buckets with a small hole in the bottom; as each bucket goes down, it carries a supply of air, which escapes gradually through the hole and rises in bubbles to the surface. By this plan the water can be purified and kept in good condition. Mr. GRAFF stated that he was a believer in the efficacy of circulation and aeration, and had tried the latter at the Belmont reservoir, Philadelphia, in 1872, the water from the supply main falling into a basin before entering the reservoir. Mr. S. L. COOPER stated that aeration by throwing the water up in a jet was tried at the Croton reservoir, and Mr. CROES also stated that at the Boyd's Corner's dam and the dam on the middle branch of the Croton the outlet water was thrown up in jets; the results of this aeration have proved very satisfactory.

The discussion was extended and interesting, and after its close, Mr. P. F. BRENDLINGER described the method of injecting grout filling behind the walls of the tunnel of the new Croton aqueduct. A double-acting hand pump, operated in the same way as an old-fashioned fire-engine, is used, the 3-in. suction nozzle being in the box of grout, which is composed of sand and cement—1:1—and the discharge nozzle being inserted in holes drilled in the brickwork. These holes are arranged in a certain order so as to be sure that the spaces behind the masonry shall be well filled, and in some cases the grout traveled 100 ft. A gauge on the discharge pipe had registered a pressure of 120 lbs. A flash-light photograph was shown, illustrating the operating of this work in the tunnel.

The afternoon session was opened by the presentation of a progress report of the committee appointed to investigate the causes of the South Fork Dam disaster. Mr. FTELEY, in presenting the committee's report, stated that no complete report could yet be made, as there was still much information to be gathered, and as the verdict of the Society would carry considerable weight, it was premature to state any reasons. At the same time, there was no doubt that if the spillway had been of sufficient capacity, the disaster would not have occurred. The committee had made surveys themselves, and it had been an interesting sight to see a president and two past presidents of the Society carrying and using the instruments on this work. The main question turns on the capacity of the overflow, the capacity of the reservoir, and the area of the water-shed. Very conflicting statements had been made as to this latter area: if as large as it has been stated, it may not be exceptional; if, however, it is as small as has been stated, the rainfall must have been abnormally great. It is very essential that the truth of this matter should be known, as it may show that other dams are unsafe in the light of recent experience. A complete survey will therefore have to be made of the water-shed and of the strip of land between the contours of the water level on the evening previous to the disaster and at the time of the disaster. The depression of the middle of the dam, he thought, had been overestimated. Some of the masonry of the bottom of the original gate tower still remains. It is hoped to present a report at the first meeting in September.

Mr. COLLINGWOOD referred to the excessive rainfall at the same time at Elmira, N. Y., and the high floods, the water reaching 18 ins. higher than at any previous time. At the headwaters of the Chemung the timber has been largely cut away and whole tracts of land denuded, so that the water flows directly to the streams. Dams which were formerly perfectly safe, because the water could not get rapidly into the streams, may now be unsafe, as the water can get rapidly into the streams, causing a serious rush of water. Mr. MACDONALD referred to the rise of the Potomac river. Mr. BOGART stated that Gen. GREELEY, of the U. S. Signal Service, has promised to furnish all available information in regard to rainfall, and it may here be mentioned that the committee will be glad to receive any data in regard to the rainfalls at the time of the accident.

In answer to a question by Mr. BRENDLINGER in regard to the failure of the dam in 1860 or 1862, Mr. FRANCIS stated that he had been informed that it was due to a defect in the masonry culvert, part of which broke and caused a cave-in of the bank; it took 11 hours to empty the reservoir, and little or no damage was done by the water. It had been stated that the crest of the dam was cut down 10 ft. when the dam was rebuilt, but it was shown that this could not have been, allowing for the slopes and the width of crest; the fact seemed to be that it had been cut down about 2 ft. in order to make a good roadway across the top. The spillway was not deepened, however, and this extra 2 ft. of height might have given the structure a fighting chance.

Mr. W. J. MCALPINE, one of the oldest and most experienced constructors of dams in this country, made some very interesting remarks in regard to this class of work, citing the early practice with the dams of the Chenango and other New York canals. (See ENGINEERING NEWS, Nov. 17, 1888.) His remarks were listened to with great attention. The crest of the South Fork dam was originally 10 ft. above the spillway, now about 7 or 8 ft., which confirms the statement as to the cutting away of 2ft. of the crest. He then read some notes on this subject and a paper on "A Method of Determining the Necessary Maximum Capacity of the Automatic Spillway of a Reservoir," which we print elsewhere, and which is of special value, coming from an engineer of such wide experience as Mr. MCALPINE. Mr. FARGUSSON referred briefly to a French practice of mixing hydraulic lime with earth for earthen dams (12 cu. dec. of lime to 1 cu. m. of earth).

The last paper of the session was that by Mr. DESMOND FITZGERALD on "Some Maximum Rainfalls in Boston," which was read by the Secretary, after which the meeting adjourned until Monday. The remainder of our report of the proceedings, and the list of members present, we defer until next week.

American Ry. Master Mechanics' Association.—*22d Annual Convention.* (*Concluded from page 580.*)

WEDNESDAY, June 19.

The carriage drives on Tuesday afternoon and the enjoyable concert rendered by the Rochester Mandolin Club in the International parlors during the evening made the members of the Convention sleep long and hard, and it was sometime after the regular hour for reassembling before the Convention was called to order.

The discussion on driving boxes was resumed, and was participated in by Messrs. SWANSTON, COOKE, SINCLAIR, SPRAGUE, LAUDER, MACKENZIE, GRIFFITH, BRIGGS, MCCRUM, and a number of others. The discussion showed a great variation in practice among the different members. The type which seemed to be the favorite was the cast-iron box with 3 or 5 brass gibs and babbit metal between them. The hexagon and "half-moon" solid brasses each found defenders, however, and Secretary SINCLAIR called attention to the experience of the New York elevated roads as showing most excellent results from the solid bronze box. Considerable testimony was given to prove that the more babbit was used in the box the faster would be the journal wear. Mr. LYNE explained that the faults found with babbit metal were generally due to improper treatment or the use of a wrong composition. ISAAC BABBIT'S original formula was 4 lbs. copper, 8 lbs. antimony, and 24 lbs. of tin, and for the lining metal the same, with 96 lbs. of tin. On casting babbit into grooves in the brass, the grooves should be first cleaned perfectly of all sand; and the sand blast was the only cheap and efficient method of doing this. The groove should then be turned and the babbit poured in hot, so that it would alloy with the brass. Babbit was greatly improved also for wear if it was peened with a hammer, or better yet if it was compressed into the groove by direct pressure. The Edison Machine Co. is using a bearing for high speed machinery consisting of a brass with spiral grooves filled with babbit running toward the center from each end. There was trouble with this device until the plan of compressing the babbit in the grooves was tried. Since then the bearing has been a perfect success.

Mr. MCCRUM (K. Cy., Ft. S. & Gulf) and Mr. BRIGGS (K. Cy., M. & B.) called attention to the use of babbit for taking up the lateral wear on driving boxes. Brass pins were put in the face of the box to hold the metal. It was the most successful device they had tried.

On the whole, the discussion showed no tendency to unite on any one form of box as the best. The 3 and 5 gib style, the hexagon and half-moon solid brasses, were each strongly approved and as strongly condemned.

After a brief recess to enable members to pay dues and new members to sign the Constitution, the report of the Committee on Exhaust Pipes and Nozzles was called for, but was not ready, and the committee was continued another year.

Secretary SINCLAIR then read the report on the best form of boiler covering, by G. W. STEVENS (L. S. & M. S.), JOHN MACKENZIE (Nickel Plate), and T. B. TWOMBLY (C. B. I. & P.). The report stated that wood covering was cheapest in first cost, but owing to its short life and the loss of its non-conducting power it was in the end a costly covering. An air space next the boiler was a decided advantage; and the plan of applying to the boiler a coating of non-conducting and non-corrosive material, preferably plaster of Paris, was warmly recommended. It was also believed that, in the interests of economy, the portions of the boiler now left naked should be protected in some manner.

Mr. J. W. LAUDER, (Old Colony) referred to the experiments carried on by the Massachusetts Institute of Technology, to determine the value of various non-conductors. These experiments knocked the stuffing out of seven-eighths of the patent non-conductors so-called, in the market. They proved that air was about the only real non-conductor of heat, and that the efficiency of a substance as a non-conductor depended on the number of air cells it contained and the degree to which its fibers held the air entangled. In practice he used a thin coating of asbestos next the boiler, and then a wood lagging. By this method the wood lasted for many years without charring. He advised protecting the front part of the boiler leg, especially, in view of the rapid air current which strikes it.

GEO. GIBBS (C. M. & St. P.) said the plastic asbestos was not as efficient as the old wood lagging. The felted asbestos was better than the plastic.

Messrs. GRIFFITH (D. L. & W.) and STEWART (Fitchburg) had each had long experience with asbestos lagging and heartily commended it. It was practically indestructible; and when a leak occurred in the boiler, the lagging could be easily removed over it, the leak be stopped, and the covering be replaced, when it was as good as new. Wood would only last about four years, and at the end of one year its value as a non-conductor was practically gone. First cost of wood was about $25, of asbestos, about $55.

J. DAVIS BARNETT (Grand Trunk) used a silicate cloth (mineral wool) covering. Channel irons 4 ins. deep were put on the boiler lengthwise, and over these a galvanized iron netting. Over this was put a layer of the silicate cloth about 1 in. thick. An air space was thus left between the boiler and the silicate cloth. This covering was practically indestructible, and could be easily removed and replaced.

Mr. CHAS. BLACKWELL (C. R. R. of Ga.) advised a chemical test of asbestos before using. Some brands would corrode the boiler very badly.

The report of the committee on driver-brakes was read by CHAS. BLACKWELL, chairman of the committee, which included also Messrs. H. D. GORDON (P. W. & B.), and W. H. THOMAS (E. T. Va. & Ga.). The report showed

that 7,500 sets of the Westinghouse brake and 3,800 sets of the American brake were in use, while the Eames brake was in use on 564 different railways. The practice of using steam or vacuum on locomotives when compressed air is used for the train was favored by many. But when this is done the committee recommended that the brake be operated by the same handle applied the train brake. The "clasp" style of brake was recommended for use rather than the "spread" style, where possible. The principle of the Ross shoe was unhesitatingly recommended. The most desirable ratio between brake shoe pressure and weight on rail was set at 30 to 35 per cent. (the Ross shoe and clasp brake being used). "The Le Chatelier or water brake is practically a driver brake, and as a device for holding engines on heavy grades is too little known." The desirability of standardizing the driver-brake heads and brake shoes was referred to.

Mr. BLACKWELL said that since the committee's report was in type the Beal's Brake Co. had reported 55 sets of their brake in use.

Mr. RAMSAY (Ill. Cen.) said that the Eames brake gave better satisfaction than any other he had ever used.

The discussion was carried on by Messrs. JEFFREY GIBBS, LAUDER, BRIGGS, FERGUSON, ROBERTS, MACKENZIE, and others. The most practical point brought out was the great value of the driver brake in conjunction with the Ross type of shoe to keep the outer portion of the tread of the tire worn down and enable the engine to make a much greater mileage before it was necessary to take her to shop to have her ties turned. Mr. ARP (C. S. & L. & P.) told of a 16 x 24 in. passenger engine on his line, which was fitted with a driver brake and Ross-Meehan shoes, and ran 130,500 miles without having tires turned. Another engine was mentioned, which made 168,000 miles before tires were turned. On this account the bulk of opinion was, that it was best to use the driver brake for every stop. To avoid confusion in an emergency, the use of one brake handle for train and engine brakes was generally commended.

The discussion of the report on axles for extra large tenders was then resumed. The discussion brought out much diversity of opinion on almost every point. The balance of opinion, however, was that the proposed increase in the size of the journal was needed to obtain sufficient bearing surface to prevent heating, and not on the score of strength. The collarless journal seemed to be generally favored, but opinion was divided as to whether a lip on the brass or a cast-iron wedge was the best means of avoiding end motion when this was used. Several were strongly in favor of increasing the size of the journal to 4½ or 4¾ ins., and others considered that a truck for 60,000-lb. cars was more needed than an axle.

The Committee on Foundation Ring for Boiler Leg,—Best Form and Advisability of Double Riveting, reported that the foundation ring should be made deep enough to receive two rows of rivets all around. They also recommended machining the ring at the corners, both outside and inside. In the discussion of this subject, which was delayed till the next day, Chairman LAUDER, of the committee, explained that a chief argument for adopting the committee's recommendations was that the use of shallow fire boxes set above the frame was everywhere fast increasing. Leaks around the foundation ring, with this type of fire box, were extremely difficult to reach and stop. The cost of machining, as recommended, was very slight, and would result in great saving in the long run. He also thought that, with the two rows of rivets, the bottom of the fire box would be so solid, that grooving would no longer take place. A type of construction largely used in Europe was referred to by Mr. HICKEY (Mil., L. S. & Wn.), in which the wind ring has a flange running down, which is riveted to the fire box sheet. Mr. MACKENZIE (Nickle Plate) believed that if ⅝-in. rivets were used instead of ⅝-in. a single row would be ample. Leaks were generally due to bad workmanship at the corners. "We machine the corners and fit the plates to them hot."

The reading of the committee's report above was followed by the adoption of resolutions placing Messrs. GEO. RICHARDS and JOHN THOMPSON on the list of honorary members.

THURSDAY, JUNE 20.

At the morning session, J. DAVIS BARNETT (Grand Trunk) read the report of the Committee on Best Proportion of Grate and Flue Area, which was signed also by Messrs. F. W. DEAN and PHILIP WALLIS. The committee issued a carefully prepared circular letter to obtain information from members of the Association, but they received but few replies. The report was accompanied by two carefully prepared papers by Messrs. BARNETT and DEAN. In discussing it, the former called special attention to the value of increased length of flue in the case of a high vacuum in the smoke box.

After the discussion noted in yesterday's proceedings the report of the committee on "Water Space Surrounding Fire Box and Flues of Locomotives, Is it Usually Large enough for Free Circulation?" was read by the Chairman JOHN HICKEY (Mil., L. S. & W.). The committee received 7 replies to their circular letter and found a nearly unanimous sentiment in favor of increasing the space between the inner and outer sheets of the fire box to 4½ ins. on the back and sides and 5 ins. on the front. The space between the tubes should be not less than ¾ in. and the tubes should be in vertical rows. The report was one of the most important and ablest presented to the Convention, and we hope to find space soon for its reproduction in this journal.

The point of interest brought out in the discussion which followed was that the increase in space between the sheets would require longer stay bolts, which would be less liable to break. Several favored a taper in the water space, making it larger at the top and the bottom. But Mr. MCKENZIE said such an arrangement led to trouble when pieces of scale from the top of the crown sheet dropped down into the water space in washing off the boiler. Mr. LYNE favored the use of scale-preventing compounds, and instanced some favorable results with kerosene.

The President appointed JOHN HICKEY (Mil. L. S. & Wn.), H. TANDY (N. Y., Ont. & Wn.) and WM. GARSTUNG (Ches. & O.) to report subjects for discussion at the Convention of 1891.

"The Magnetic Influence of Iron and Steel in Locomotives on the Watches of Engine Runners," was the last committee report to be presented. Messrs. T. W. GENTRY, JAS. MEEHAN and HARVEY MIDDLETON, the committee, reported that they could find no evidence that the magnetism, if any existed, in locomotives, had any effect on the watches of the runners. Jolts and jars of the ordinary service were the cause of much of the irregularity often laid to magnetism. Exposure to dynamos and electric light apparatus they considered a real danger and one that should be guarded against in some manner. Mr. LYNE said that a timepiece to be used by a railway man should have a much quicker beat than a watch for ordinary use. He favored the watch with works absolutely non-magnetic rather than the non-magnetic shield.

The committee on subjects for discussion at the next annual meeting reported the following list:

1. Compound locomotives. Their relative efficiency as compared with simple engines. Is the saving in fuel large enough to compensate for the extra cost of compounding and of maintenance of an increased number of parts? Are the conditions of American railway practice such as to make compounding advisable?

2. Testing laboratories, chemical and mechanical. Are they desirable in connection with the mechanical department of railroads? Does a marked saving in expense, by ensuring better material through chemical analysis and physical tests, result?

3. The link as compared with other valve motions.—Wilson's, Joy's, Walschaert's, etc. Has any device been found, worthy to supersede the old style link for economical service on locomotives, considering first cost, cost of maintenance, convenience, etc?

4. Aside from increasing grate area, are there any other advantages to be gained by placing fire boxes above the frames?

5. Steel vs. iron axles. As regards friction, wear of journals, and journal bearings, liability to breakage in service, etc.

6. Brick arches in locomotive fire boxes. Best manner of supporting them. Their efficiency in consuming the various gases composing black smoke, saving of fuel when used in connection with extension front; and as compared with the diamond stack, first cost, and cost of maintenance.

7. Locomotive tanks on tenders. Best method of preventing corrosion in coal space. Will it pay to shield the surface exposed to coal? If so, what is the best material and how should it be applied?

8. The best proportion of steam passages in relation to the size of cylinders and steam pressure.

The report of the committee was accepted, and on motion the following subjects were added:

9. The best form and size of axle for heavy tenders and cars.

10. The present status of the "automatic-coupler question," and whether this Association can endorse the action of the M. C. B. Association in recommending the vertical plane type as a standard from a mechanical point of view.

The following resolution was adopted with much enthusiasm:

Resolved; That it is a duty incumbent on every member of this Association to answer all circulars issued by its committees as early at least as May 1.

The discussion of questions submitted by members was then taken up, and Mr. NOBLE (Tex. Cen.) opened the subject of the relative proportions of cylinder and stack diameters. He had made some experiments lately in reducing the size of stacks and enlarging the nozzles. Engines with 16-in. cylinders, 12-in. stacks and 4¼-in. exhaust nozzles had given an evaporation of 7.25 lbs. of water per pound of coal.

Mr. GENTRY (Richmond & Danville) had also been reducing the size of stacks with good results.

Mr. MONTGOMERY (C. R. R. of N. J.) had been doing the same thing and also increasing the size of exhaust nozzles. He had tried a "torpedo" (a cone-shaped piece at the base of the stack to spread the current of the exhaust) and had found it an excellent device. The draft was steadier and higher, and the engineers reported a less consumption of coal.

Messrs. HARRINGTON and WEST, of the Erie, STEWART of the Fitchburg, and BOON of the West Shore reported some surprising results in the use of one stack of uniform size for all classes of engines. The Erie stack is of cast-iron, 15 ins. at the bottom and 23 ins. at the top; the same size is put on all engines. It costs, fitted up, about $13. It is showing remarkable results in the economy of fuel. The same stack is standard on the Richmond & Danville. It was claimed that this stack, without an extension front end, would throw no fire and would collect no sparks in the smoke box. Mr. BOON (West Shore) uses a 13¾-in. straight stack on all engines, and it works admirably.

Most of the members seemed rather staggered at the results of this innovation on old and long established principles, and were at a loss to understand how the same size stack could show equally good results on a 12-in. and on a 22-in. engine. Mr. LAUDER laid down the general principle in regard to the extension smoke box that its sole and only use was as a place to deposit sparks in. So long as it was necessary to burn from 40 to 120 lbs. of coal per hour on each square foot of grate surface, so long would a considerable amount of unconsumed fuel, cinders and ashes be drawn through the tubes, and if not deposited in the smoke box they must be thrown out into the air. In this connection Mr. STINARD (Erie) instanced the testimony of the Yankee master mechanic who, when in the witness box, was asked whether there was any known means to prevent sparks being thrown from a locomotive. He replied, "Put no coal in the fire-box."

Mr. MACKENZIE introduced the subject of false cylinder-seats. Is it necessary to fasten them down when used with a balanced valve? He had known the false seat to lift from its place when the engine was reversed. No one else had had a similar experience, but Mr. MACKENZIE thought this was due to the fact that, with the balanced valve generally used, only a part of the steam pressure was balanced.

The subject of cast-iron wheels under engine trucks was introduced, but was laid over to next year.

The Auditing Committee's report was read and accepted; and an invitation from J. M. TOUCEY, General Superintendent of the New York Central & Hudson River, to take an excursion to Toronto on Friday, via the Port line of steamers was also accepted, a good number of members signifying their intention to go.

The matter of giving more time for the discussions by omitting the reading of the reports of the Committee on Technical Subjects was brought up; but the reform was opposed by Secretary SINCLAIR and others and no action was taken.

The report of the Committee on the Next Place of Meeting was read, and gave the following list of places: Chattanooga, Buffalo, Montreal, Denver, Old Point Comfort. According to the constitution, a ballot was then taken and the vote stood as follows: Chattanooga, 29; Buffalo, 12; Montreal, 8; Denver, 6; Old Point Comfort, 4. The first of these three places, having received the highest number of votes, will be eligible for choice by the Executive Committee in their final decision on the next place of meeting.

Mr. L. R POMEROY, Secretary and Treasurer of the Suburban Rapid Transit Co., of New York City, was elected an Associate Member.

The report of the Nominating Committee was taken up, and R. H. BRIGGS, of Memphis, Tenn., was elected President; JOHN MACKENZIE, Cleveland, Ohio, First Vice-President; ALBERT GRIGGS, Providence, R. I., Second Vice-President, O. STEWART, Charlestown, Mass., Treasurer; and ANGUS SINCLAIR, New York City, Secretary.

On motion of Mr. BRIGGS, the association, by a rising vote, tendered its thanks to the retiring President, Mr. J. H. SETCHEL, and followed it up with three rousing cheers.

By report of the Committee on Resolutions thanks were tendered to Rev. C S. STOWITTS, President SHELDON and the various firms represented at the convention. Especial mention was made of the excellent musical and literary entertainment furnished on Tuesday evening; the excursion under the auspices of the Rotary Snow Shovel Co., on Wednesday afternoon and the excursion through the courtesy of the New York Central on Friday.

Final adjournment was taken at 2 P.M.

EXHIBITS AT THE CONVENTION.

A room in the first floor of the building, where the meetings were held, was taken up by exhibits of various railway supply firms. These were generally very creditable, and deserved much ampler space and a better lighted room for their exhibition.

One of the most interesting was the large display of the Thompson Electric Welding Company, which was an entire novelty to almost every one. Pieces large and small were shown which had been welded by the electric current, and several which had afterward been tested to the point of fracture. If the system is to be as safe and economical in practice as it is effective, its possibilities seem almost boundless.

The car heating men were out in full force. The Erie, of Erie, Pa., the Standard, of Pittsburg, the Northwestern Modern, of St. Paul (described in ENGINEERING NEWS, March 30, 1889), the Gold, of New York City, the National, of Albany, the Shackleton, of Bound Brook, N. J., the Martin, of Dunkirk, N. Y., the Knapp Steam Coupler Co., of Syracuse, N. Y., the Leland Universal, of New York City, and the Williames, of Boston, were all shown more or less fully by drawings, models, or full-size details.

One of the neatest hits of the convention was made by Mr. R. G. CHASE, of the Williames Company. During the concert Tuesday evening the air in the parlor became very close and warm, and the few ladies who had brought their fans down with them were objects of envy. Just at this juncture a liberal supply of neat Japanese fans appeared and was distributed. On the back of each it was modestly explained that it was the province of the Williames Car Heating Company to furnish air as well as heat.

Car seats were shown by the Roberts Woven Wire Car Seat Co., of Hartford, Conn., the Scarritt Car Chair Co., and the Hale & Kilburn Co., of Philadelphia.

In packing for protecting steam pipes, etc., exhibits were made by the H. W. Johns Asbestos Co., the Chalmers-Spence Co., the Asbestos Packing Co., of Boston, and the Shields & Brown Co., of Chicago, the last company showing their sectional insulated coverings.

Vulcabeston packing for valves, cocks, etc., was shown by Fairbanks & Co., with various cocks, valves, etc., packed with the material. The Western Valve Co. also had a good exhibit. Fairbanks, Morse & Co., of Chicago, were represented by Mr. F. O. MCARTHUR, and showed their hand-car, track, jack, etc.

The Jule Centrifugal Snow Plow was shown by a model, and its competitors, the "Rotary" and the "Cyclone," had photographs of their machines on the walls. The big "Cyclone" machine was to have been present at the Convention, according to report, but as it was not fitted with a brake, the railway companies declined to haul it.

Car doors were shown by the Metallic Grain Door Co., of Detroit, and the Ruffhead Flush Car Door Co., of Williamsport, Pa.; the latter company also exhibited a positive nut-lock.

Among the car-coupling exhibits were four new candidates for favor. The Robinson Coupler, of Springfield, O., the Automatic, invented by Joseph Tocin, of Buffalo, the Butler Draw-Bar, Allachmer & Co., of Cleveland, and the Fennell, of Skaneateles, N. Y. The Safford Safety Draw-Bar was also represented.

Some of the most interesting exhibits were those showing articles in pressed steel. The A. French Spring Co., of Pittsburg, showed a rolled steel box lid. The Michigan Ry. Supply Co., of Detroit, showed the "Central" steel brake beam, made from one piece of plate steel. A 52-lb. beam, tested at Altoona, Apr. 3, 1889, by A.S. VOGT, Mechanical Engineer of the Pennsylvania R.R., showed a deflection of 0.09 ins. under a load of 10,000 lbs., 0.24 ins. under a load of 20,000 lbs., and broke under a load of 30,507 lbs. The Schoin Manufacturing Co., of Philadelphia, showed their hot pressed steel center plates and stake pockets. A very fine exhibit was made by the Fox Solid Pressed Steel Co., of Chicago. Their model of a complete truck frame in pressed steel received much notice.

Among the valve companies represented were the Mason Regulator Co., the Ashcroft Mfg. Co., the Ross Reducing Valve Co., of Troy, N. Y., Barnum's Automatic Cylinder Relief Valve Co., Buffalo, N. Y., Pendriy's balanced throttle valve, made by the Hoffman Machine Co., of Detroit, Mich.; the Glace triple-sheet check valve, made by J. E. Lonergan & Co., of Philadelphia; the American balanced piston, and balanced slide valves, by WM. J. THOMAS, Sansalito, Cal; the Richardson balanced slide valve, of Troy, N. Y., and the Foster reducing valve, of New York City. A portable machine, for refitting globe valves without removing them, was shown by C. F. Hall & Son, of Skaneateles, N. Y.

A Halsey's Portable Power Drill was exhibited by J. J. MCCABE, of New York City. The Skinner Combination-Check, by the Union Mfg. Co., of New Britain, Conn., H. BELFIELD & Co., of Philadelphia, showed their lifting locomotive injector.

The Union Switch & Signal Co. had a full size Westinghouse friction buffer. The Westinghouse brake apparatus was shown; and the Eames Co. had a model of their ejector, and blue prints of their equalized brake, style G. Porter & Grosvenor of Detroit, had an automatic safety air-brake hose coupler.

Some tempered copper bearings were shown, by the Anti-Friction Metal Co., of North East, Pa. The Damascus Bronze Co., of Pittsburg, also showed high-grade bearings.

The Kalamazoo R. R. Velocipede, the Tilden re-railing frog for cars and locomotives, the Detroit Cylinder Lubricator, the Ross and Ross-Mehan brake shoes, the American Solid Steel Car-Wheel, the machined car wheel of the New York Car-Wheel Co., of Buffalo, the portable forge made by the Star Machine Co. of Buffalo, were all good exhibits.

Interesting novelties were shown by the Hartford steel railway tie, Watt's combination tail lamps, the Griggs electric air signal, Shaffer's oil saver, Otley's steam packing cement, the silk machine wipers, made from silk waste by the American Silk Mfg. Co. of St. Louis, and the waterproof roofing and sheathing papers made by F. W. Bird & Son, of East Walpole, Mass., jacks by D. E. MCSHERRY, of Dayton, O., the Boies steel wheel, the Jerome packing The McGuire Manufacturing Co. of Chicago, Manning' Maxwell & Moore of New York, the Buffalo Steam Pump Co., the Non-Magnetic Watch Co., of New York, and the Gould Tisdale Semaphore, were among the other firms and specialties represented.

The Rensselaer Polytechnic, of Troy, held its commencement exercises on the evening of June 19. Bishop HENRY C. POTTER addressed the graduating class, being called upon, as he remarked, at the eleventh hour to supply the place of the Hon. CHAUNCEY M. DEPEW, who was unavoidably absent. Mr. D. GUILFORD SMITH presided at the alumni banquet in the afternoon, and during the dinner a telegram from Paris was read announcing that the Rensselaer Polytechnic Institute had been awarded a first premium as an engineering school. Prof. JAMES HALL, '32, and Mr. GEORGE H. COOK, '39, were requested to prepare a memoir of the institute as far as they could recollect, to supply the place of institute records destroyed in the late fire; they promised to do so. Degrees were conferred upon the following members of the class of '89: FRANK CHATTERLY BATES, Brooklyn, N. Y.; EDUARDO J. CHIBAS, Santiago de Cuba; JOSIAH MADISON ESTEP, Cadiz, O.; GEORGE S. GROESBECK, Lansingburg, N. Y.; PAUL OCTAVE HÉBERT, Marietta; EDWARD M. HOADLEY, New York city; HERBERT ARMSTRONG JAGGARD, Altoona, Pa.; EDWIN SETON JARRETT, Buffalo, N. Y.; JOHN ALFRED KIMBERLY, Jr., Neenah, Wis.; JULIUS A. LUDWIG, Richmond, Va.; CHARLES MORTON PARKER, St. Louis, Mo.; MARCUS POWELL, Brooklyn, N. Y.; JOSEPH BENJAMIN RIDER, Norwalk, Conn.; CLARENCE SUDDEN, Pittsburg, Pa.; JOHN ARNOLD UBSEELL, Jr., Port Eads, La. LOUIS E. MUNOZ DEL MONTE had the degree of Bachelor of Science conferred upon him. The degree of Civil Engineer was also conferred on the following, who had held over: ALBERT AUGUSTUS WIGAND, New York city; THEODORE HENRY WILLIAMS, L'Anse, Mich.; SANTIAGO FORTUN-Y-ANDRE, Havana, Cuba.

New England Water-Works Association.—(*Concluded from page 579.*)

Mr. FROST.—I am personally interested in this matter. At Plainfield, N. J., the city in which I live, they are just now discussing works. It is the largest city west of the Alleghenies that is not provided with works. The population is 12,000 and the town is entirely free from debt. A large part of the inhabitants are men whose business is in New York who go home in the evening. The old residents are opposed to bonding the town and are strong enough numerically to prevent it. The last meeting was held last Monday evening. The question which I would like to place before this convention is this: The city is entirely free from debt and can borrow money at 3 or 4 per cent. Mr. HERING has given them specifications for works that will cost $200,000. They want to couple sewerage with the water supply, at a cost of about $400,000. They want to grant a franchise for the whole work; but have not discovered any method for giving one. What is the best thing for the town to do? The only town I know of which has such a system is Shreveport, La. SAMUEL R. BULLOCK built the works there. They have a system of sewerage under franchise. Is it better for Plainfield to borrow money at 4 per cent., or shall they give a franchise?

Mr. DARLING.—No private corporation can live in any city or town if it is dependent entirely upon family supply. It cannot be made to pay. You must have corporations that will use large quantities of water and also have a good hydrant rental. Large manufactories may compensate in a manner for the lack of corporation demand. If you have a city of 35,000, with a prospect of a good supply being required by the corporation, I would say that your city would do better to put in its own works than to let somebody come in there. If you have not got the manufactories, I doubt if you can get any company to build works. There are cities and towns in this country that pay $100 per hydrant and some pay $150. High hydrant rental, of course, will be an inducement for them to put in the works. The average rental for works is $50. A fair price is $30 to $35.

Mr. WILDER.—I represent a small system which is owned by a private corporation. Our agreement is to have the hydrant rental revenue pay 4 per cent. on the investment. This makes the rental $26 per hydrant. We allow them to set as many hydrants as they choose as the pipe is laid down. The citizens are perfectly satisfied, and I have no doubt they will be glad to renew their contract when it expires. I think our price (at Woodstock, Vt.) is as low as any in the State of Vermont.

A MEMBER.—In our town we could not get a vote for works, because they could not agree as to whether it was best to build them ourselves or let a private company in. One wanted it and another did not. Mr. WILEY went there and made a contract to furnish them with hydrants for domestic supply and put in works. I do not know that there has been any fault found with the private company, and do not know but that they give satisfaction.

A MEMBER.—I represent a private water company. We do not charge the city anything for fire purposes. We make a living, and lay pipes anywhere where they pay 5 per cent. on the cost.

Mr. FALES.—Tonawanda is one of the largest lumber ports in the world. When the question of water-works came up, it was very much as the gentleman at Plainfield has said, the population was about equally divided in regard to nationality. The town is divided into the north side and the south side, and they are running each other. Part of them were in favor of and part against establishing works. Connected, as I was, with a water company, I made a contract with the north side of the town, with a population of 6,000; the south side at first refused to make one. We were to put in six miles of mains and furnish a perfect fire protection. Members of the council were to decide how many hydrants would be set. We were to receive $40 per year for each 400 ft. of pipe laid. There were 97 hydrants when the works were completed. In regard to private corporations not laying mains fast enough, we first laid them charging only actual cost to parties on the line, and then asked the council to accept them. On the south side they had 8 miles of mains laid, and were to have as many hydrants as they saw fit, and paid $40 per year for every 400 ft. We have tried to make the rates as low as possible, and $40 is the lowest amount that could be received to pay for the works.

A MEMBER.—Do you pump?

Mr. FALES.—We have two Gaskill pumps, made by the Holly Mfg. Co., and direct pressure. Our ordinary pressure is 40 lbs.; fire, 80 to 120 lbs. We use the Wyckoff pipe, made by the Michigan Pipe Co., Bay City, Mich., and have had no breaks in them at that pressure. Our contract is for 20 years, the town having the privilege of buying the works at any time.

Mr. DARLING.—I think it is a mistaken idea for any city or town to assume that their works should supply the hydrants for nothing. I would like to ask what business man, if he had three or four classes of business, would take from one to the detriment of the other? It is best to make each department an institution by itself.

Mr. HALL.—I think the remarks of many of the members here to-night show that many small places are supplied with water by private corporations, that otherwise would have no supply. That is the situation in the place I represent, and there are several places which I have in mind that are agitating the question of water supply that do not think it advisable to take hold and build them themselves. They have voted to contract with private companies to build the works for them. Without the private companies, many places would have no supply whatever.

Mr. NOYES.—To answer Mr. FROST'S question as to granting franchises for purposes of constructing private systems of sewers: There are two places in New Jersey where this has been done, at Atlantic City and at Long Branch. As to whether Plainfield should be supplied by the municipality or grant a franchise, I think Mr. BABCOCK has given us the whole thing in a nutshell, and I agree with him in the management by the city if they can keep politics out. That is one objection to municipal management. Ordinarily, private companies are organized to put in works purely as a matter of business, and with a view of selling them to the town within a few years. Many companies are organized to-day to build on that basis. Generally the bonds are bought in by the town in 5 to 10 years. I know of a municipality that will have to pay 33 to 50 per cent. of what the works cost and will have to build two-thirds of the works over again.

A motion for a vote of thanks to the President, Secretary, and officers of the Association for excellent services rendered was offered by Mr. NOYES, and after a duet by Messrs. PRATT and MONROE, to the accompaniment of Mr. MILLIGAN of "Mary had a little lamb," in which the members joined in the chorus, final adjournment was made.

On Friday an excursion to Bullock's Point was given, where a New England clam-bake was served to about 300, including members and visitors.

The following gentlemen were unanimously elected members:

ACTIVE.

CARROLL PH. BASSETT, C. E., Newark, N. J.; J. WHITE BELCHER, Water Commissioner, Randolph, Mass.; C. EMMETT BENNETT, Superintendent, Ticonderoga, N. Y.; H. M. FALES, Superintendent, Tonawanda, N. Y.; H. W. GREETHAM, Manager, Orlando, Fla.; BENJ. P. HALE, Registrar, Haverhill, Mass.; WM. T. HARBACH, Commissioner, Newton Center, Mass.; L. M. HASTINGS, City Engineer, Cambridge, Mass.; AMEL G. HAYES, Assistant Superintendent, Middleboro, Mass.; E. H. KEATING, City Engineer, Halifax, Canada; W. H. LAING, Superintendent, Racine, Wis.; EDW. T. E. LANSING, Little Falls, N. Y.; AUGUSTUS W. LOCKE, C. E., North Adams, Mass.; H. H. LOWE, Superintendent, Clinton, Mass.; ROB'T K. MARTIN, Chief Engineer, Baltimore, Md.; JOHN F. PLUNKETT, Registrar, Marlborough, Mass.; G. A. ROULLIER, Superintendent, Flushing, N. Y.; E. T. WISWALL, Commissioner, West Newton, Mass.; M. F. WRIGHT, Superintendent, Lowell, Mass.

ASSOCIATE.

AMERICAN FROST METER CO., Boston, Mass.; CHARLES H. EGLEE, Contractor, Flushing, N. Y.; GALVIN BRASS & IRON CO., Detroit, Mich.; JOHN HATTERSLEY, Common Sense Packing, Brooklyn, N. Y.; NATHANIEL C. LOCKE, Damper Regulator, Salem, Mass.; SAMUEL L. MORISON,

United Brass Co., New York City; WALTER B. NYE, Warren Filter, Boston, Mass.; WM. WOLFENDALE, Plumbers' Supplies, Fall River, Mass.; N. F. RYDER, Varnish Manufactory, Middleboro, Mass.; PORTSMOUTH WRENCH Co., Boston, Mass.

The following members, representatives, and visitors were present:

HONORARY.

E N. JONES, Boston; GEO. H. FROST, ENGINEERING NEWS, New York.

ACTIVE.

HIRAM NEVONS, President, Cambridge, Mass.; R. C. P. COGGESHALL, Secretary, New Bedford, Mass.; ALBERT S. GLOVER, West Newton, Mass.; PATRICK KIERNAN, Fall River, Mass.; W. M. HAWES, Fall River; G. E. WINSLOW Waltham, Mass.; JAS. L. LUSK, Washington, D. C.; C. E. BOLLING, Richmond, Va.; JOS. A. LOCKWOOD, Yonkers, N. Y.; G. A. ROULLIER, Flushing, N. Y.; WEAVER OSBORN, Fall River; EDWIN DARLING, Pawtucket, R. I.; BYRON L. CLARK, Woonsocket, R. I.; A. G. PEASE, Spencer, Mass.; H. W. CONANT, Gardiner, Mass.; W. W. BABBITSON, Fall River; DEXTER BRACKETT, Boston; R. M. GOW, Medford, Mass.; A. H. SALISBURY, Lawrence, Mass.; H. W. ROGERS, Salem, Mass.; JASON GILES, Boston; R. R. YATES, Northboro, Mass.; G.A. KIMBALL, Boston; F. W. WILDER, Woodstock, Vt.; D. B. KEMPTON, New Bedford, Mass.; C. H. BALDWIN, Boston; G. F. CHASE, Taunton, Mass.; E. H. KEATING, Halifax, N. S.; J. M. CLARK, Northampton, Mass.; A. W. INMAN, Boston; J. F. PHILBIN, Clinton, Mass.; G. A. STACY, Marlboro, Mass.; J. W. MORSE, Natick, Mass.; H. G. HOLDEN, Nashua, N. H.; F. H. CRANDALL, Burlington, Vt.; W. H. RICHARDS, New London, Conn.; F. H. PARKER, Burlington, Vt.; F. E. HALL, Quincy, Mass.; W. B. SHERMAN, Providence, R. I.; A. F. NOYES, Newton, Mass.; J. WATTERS, Fall River; G. J. RIES, Weymouth, Mass.; J. C. HANCOCK, Springfield, Mass.; T. M. DROWN, Boston; W. F. CODD, Nantucket, Mass.; S. E. BABCOCK, Little Falls, N. Y.; F. P. STEARNS, Boston; J. E. BEALS, Middleboro, Mass.; C. H. SWAN, Boston; S. M. ALLIS, Malden, Mass.; G. B FITTS, Attleboro, Mass.; G. F. SWAIN, Boston; A. E. MARTIN, South Framingham, Mass.; H. N. HYDE, Jr., Newton, Mass.; N. DENNETT, Somerville, Mass.; W. E. NASON, Franklin, Mass.; H. L. EATON, Somerville, Mass.; C. W. MORSE, Haverhill, Mass.; J. W. RINGROSE, New Britain, Conn.; C. K. WALKER, Manchester, N. H.; F. F. FORBES, Brookline, Mass.

ASSOCIATE.

Edson Recording Gauge, New York; Chapman Valve Mfg. Co., Indian Orchard, Mass.; Locke Bros. Steam Pressure Regulator and Damper Co., Salem, Mass.; National Meter Co., New York; Common Sense Metallic Packing Mfg. Co.; Tuerk Hydraulic Power Co., New York; American Frost Meter Co., Boston; Peet Valve Co., Boston; Jenks Drinking Fountains, Pawtucket, R. I.; Stebbins Mfg. Co., Springfield, Mass.; Seiden Patent Packings, New York; Thomson Meter Co., New York; Hersey Meter Co., Boston; Henry R. Worthington, New York; R. D. Wood & Co., Philadelphia, Pa.; Galvin Brass & Iron Works, Detroit, Mich.; Oliphant Filter Co., New York; Whittier Machine Co., Boston; Ross Valve Co., Troy, N. Y.; Walworth Mfg. Co., Boston; Union Water Meter Co., Worcester, Mass.; Portsmouth Wrench Co., Boston; Duplex Seal for Water Meters, A. W. Worthley, Boston, Mass.; Water Indicator and Recorder, Geo. E Winslow, Waltham, Mass.; Builders' Iron Foundry, Providence, R. I.; Asbestos Packing Co., Chadwick Lead Works, Boston, Mass. CHAS. H. EGLEE, Flushing, R. I.,

VISITORS AND REPRESENTVTIVES.

James P. Bacon, Official Stenographer, Pemberton Square, Boston; F. W. Shepperd, *Fire & Water*, New York; F. A. Peckham, ENGINEERING NEWS, New York; E. L. Abbott, New York; H. A. Gorham, Boston, A. M. Worthley, Boston; F. W. Hood, Boston; J. H. Eustis, Boston; H. H. Lowe, Clinton, Mass.; W. Ross, Troy, N. Y.; W. P. Walpole, Fall River; A. W. Locke, North Adams, Mass.; J. B. Edson, New York; J. H. Wells, Boston; W. H. Moulton, Worcester, Mass.; L. C. Lampshear, Boston; H. W. Fales, Tonawanda, N. Y.; Prof. J. E. Denton, Hoboken, N. J.; H. Q. Saunderson, Springfield, Mass.; L. W. Turner, Boston; G. A. Polly, Boston; F. L. Pratt Cambridge, Mass.; G. F. Monroe, Boston; W. J. Milligen, Boston; W. F. Wright, Lowell; E. T. Lansing, Little Falls, N. Y.; R. Brandt, New York; A. G. Hayes, Middleboro, Mass.; E. A. Stevens, Jr., Malden, Mass.; G. L. Gould, Malden, Mass.; H. H. Fisk, Malden. Mass.; G. E. Batchellor, Boston; L. A. Palmer, Boston; G. Woodcock, Salem, Mass., Prof. W. T. Sedgwick, Boston; J. Hattersley, New York; X. H. Goodnough, Boston; C. F. Angell, Providence, R. I.; F. B. Gleason, Marlboro, Mass.; W. Webster, Boston; A H. Broderick, Boston; J. F. Plunkett, Marlboro; P. B. Murphy, Marlboro, Mass.; W. D. Doyle, Marlboro, Mass.; Thos. Burke, Marlboro, Mass.; F. W. Skinner, *Engineering & Building Record*, New York; A. A. Blossom, Boston; E. L. Ross, Boston; J. M. Betton. New York; J. C. Kelley, New York; Jesse Garret, Philadelphia, Pa.; L. McHugh, Detroit, Mich. H. D. Winton, Wellesley, Mass.; R. J. Thomas, New York; Chas. Lynch, Detroit, Mich.; F. E. Stevens, Boston.

American Association for the Advancement of Science.—The 38th meeting of the association will be held at Toronto, Ont., beginning Aug. 27. For particulars pertaining to membership, papers, or business, address the permanent Secretary, F. W. PUTMAN, Salem, Mass.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Lehigh Valley.—Surveys are reported in progress for a branch to run from Pittston, on the main line, to Scranton, Pa., a distance of about 10 miles.—Right of way is being secured for the line from Roselle, N. J., to Newark, N. J., a distance of about 8 mile. The line will ultimately be continued from Newark to Jersey City, thus giving the Lehigh Valley a route into New York.

McKeesport & Belle Vernon.—This road has been completed from Elizabeth to Elkhoru, Pa., this season and it is expected to reach Monongahela City by July 4. The road was built from McKeesport to Elizabeth, a distance of 8 miles, last year.

Chicago & Eastern Illinois.—At a meeting of the stockholders of the Evansville, Terre Haute & Chicago R. R., recently held, the formal transfer of the majority of the stock recently purchased by the Chicago & Eastern Illinois Co. was made. The Chicago & Eastern Illinois Co. has operated the Evansville, Terre Haute & Chicago R. R. since May 1, 1880, under a lease of 999 years.

Utica & Unadilla Valley.—J. A. Seno, of Bridgewater, N. Y., contractor, writes us that about 75 men and 25 teams are now at work on this road and grading is well advanced for 4 miles. There remains only one light cut to be made and the approaches to the trestle work to be filled when the grade will be ready for tracklaying. The force will be increased to about 200 men as soon as Leonardsville is reached.

Barnegat Park.—Construction has been suspended for the present on this road. The road was projected to run from Barnegat Park, N. J., to the ocean beach.

Newfoundland.—It is stated that the Government of Newfoundland will build this road as a government work. The road is projected to run from St. John's to Hall's Bay, a distance of 250 miles. Work will commence soon. H. C. BURCHELL, Colonial Government Engineer, St. Johns, Newfoundland has charge of the work.

Cornwall & Lebanon.—The directors of this company recently held a meeting at which it was voted to abandon the project of building the line from Reading to Lebanon, a distance of 25 miles.

Baltimore & Ohio.—The statement of earnings for the month of May, 1889, shows the following results as compared with the same month in 1888:

	1888	1889
Gross earnings	$1,769,184	$1,760,713
Operating expenses	1,206,044	1,249,042
Net earnings	$563,140	$511,671

Dexter & Piscataquis.—Work is being pushed on this road, and it is expected to have it completed to Foxcroft by Dec. 1.

Wabash.—The engineers of this company are now at work on the line from Wabash to Laketon, Ind., connecting the Wabash and Wabash Western railways.

Northern Adirondack.—It is announced that this road will be extended to Tupper's Lake, a distance of 22 miles.

Michigan.—The Michigan Senate has passed a bill regulating passenger fares on railways at the rate of 2 cts. per mile where the earnings are $3,000 or over per mile; 2½ cts. where the earnings are between $2,000 and $3,000 per mile, and 3 cts. where the earnings are less than $2,000 per mile. This does not apply to railways in the northern peninsula which are allowed to charge 5 cts. per mile.

Wilkesbarre & Western.—Work is being pushed on the extension of this road from Millville to Shickshinny, a distance of 20 miles. The line has been graded from Millville to Rohrsburg and it is expected to have the tracklaying completed by July 15. The line from Rohrsburg to Shickshinny will be mostly heavy work, there being considerable rock cutting. The Bellefonte & Eastern R. R. Co., which was chartered several years ago and afterwards secured by the Wilkesbarre & Western, will, it is stated, be completed and surveys will commence at once. The road was projected to run from Bellefonte to Watsonton, a distance of about 50 miles.

Delaware River & Lancaster.—Work is reported commenced on this road which is to run from Phœnixville to French, Creek, Pa.

Baltimore & Delaware Bay.—A correspondent writes us that this company is building a line from Bombay Hook to Clayton, Del. The line from Clayton to Chestertown, 34 miles, is being improved. A line will also be built from Worton to Tolchester, Md., 10 miles. One new 50-ft. span bridge will be built and all the old bridges on the line will be reconstructed.

Western Maryland.—It is stated that this company is considering an extension to run from Chambersburg to a connection with the East Broad Top R. R. The East Broad Top R. R. will, it is said, be purchased by the Western Maryland Co. and extended to a connection with the Baltimore & Ohio R. R. The object of the extension is to obtain an entrance into the Broad Top coal fields. About 100 miles of railway would have to be built to make the proposed connection. Surveys were made for the line some years ago.

Grand Trunk.—A petition has been presented to the government by the people along the route, asking that aid be given to extend the Haliburton branch of this road to Mattawa.

Projects and Surveys.

Montrose & Binghamton.—The Boards of Trade of Montrose, Pa., and Binghamton, N. Y., have jointly agreed to bear the expenses of a survey for the proposed railway between those two places, a distance of about 23 miles. The road will pass through the towns of Pierce Creek, Hawleyton and Silver Lake.

Niagara River & Erie.—Incorporated in New York to build a line of railway from a point on the New York Lake Erie & Western R. R., in Buffalo, to the village of Tonawanda, a distance of 8 miles. Among the incorporators are; HENRY W. WATSON, JOHN R. WILLIAMS, and GEO. F. BROWNELL, all of Buffalo.

Mt. Desert.—The Railroad Commissioners of Maine, have renewed the charter of this company for 3 years. The road was projected to run from Bar Harbor to the foot of Green Mt., a distance of 3 miles.

Elizabeth & Sutersville.—It is stated surveys have been made for a railway to run from Elizabeth to Sutersville, Pa., a distance of about 5 miles. A bridge is also to be built across the Monongahela river at Sutersville, to connect with the Pennsylvania R. R.

Grand Rapids & Mineral Springs.—A company has been organized in Michigan to build a line of railway from a point on the Grand Rapids & Indiana R. R., near Hall St., Grand Rapids, Mich., southwest to the junction of the Lake Shore & Michigan Southern and the Chicago & West Michigan railways. The object of the road is to develop the factories and lands along the route. FRED. W. STEVENS, of Grand Rapids, is Chief Engineer.

Presumpscot River.—At a meeting of the stockholders, recently held, the following officers were elected: GEO. P. WESTCOTT, President, and GEO. F. WEST, Treasurer. The directors were authorized to proceed at once with the construction of the road.

SOUTHERN.—Existing Roads.

Roanoke & Southern.—At a meeting of the stockholders of this road, recently held, H. S. TROUT was elected President. The road has been completed from Winston-Salem to Walnut Cove, 18 miles, and efforts are being made to secure sufficient capital to complete the line.—It is stated that this company, the Cape Fear & Yadkin Valley R. R. Co., and the Shenandoah Valley R. R. Co., will consolidate.

Charleston, Cincinnati & Chicago.—Work has commenced at Johnson City, Tenn., on this road. About 500 men are now at work and the road will be quickly pushed to completion from Johnson City north to a connection with the Chatteroi R. R. in Kentucky.

Union Point & White Plains.—Grading has been completed and tracklaying is in progress on this Georgia road.

Georgia Southern & Florida.—Tracklaying is now in progress on this road. It is expected that the road will be completed from Valdosta, Ga., to Lake City, Fla., by Nov. 1.

South Atlantic & Ohio.—The contract to build this road from its present terminus to Big Stone Gap, Va., has been let to Mason, Hodge & Co., of Frankfort, Ky.

Louisville & Nashville.—Contracts will soon be let for building the Cumberland Valley branch of this road from Cumberland Gap to Princess Flats, the terminus of the Norfolk & Western R. R.—The company will expend about $350,000 this season in repairing and renewing the bridges along its route.

Atlanta & West Point.—Work is reported in progress on a line to run from Atlanta to East Point, Ga., a distance of about 6 miles. The road now uses the track of the Central R. R. of Georgia between those two places.

Georgia Pacific.—Work is now in progress changing the line from Greenville and Johnsonville, 30 miles, to standard gauge. A regular schedule of trains will be put on the newly completed line from Columbus to Greenville, Miss., a distance of 142 miles, about July 1.

Eutawville.—Work is now in progress on this road near Sumter, S. C. The contract for building an iron bridge over the Santee river will be let soon. H.T. PEAKE of Vances, S. C., is Chief Engineer.

Norfolk & Western.—The contract for building the Clinch Valley branch to Big Stone Gap, Va., has been let to Mason, Hodge, Gooch & Co., of Frankfort, Ky.

Louisville, New Orleans & Texas.—This company has let the contract for building the Bolivar Loop.—The gauge of the Natchez, Jackson & Columbia R. R., running from Natchez to Jackson, Miss., 100 miles, is being broadened.

Hartsville.—Tracklaying is now in progress on this South Carolina road. It is expected to have the line completed by Sept. 1.

Projects and Surveys.

Gulf & Chicago.—The prospectus of this company gives the following data concerning the enterprise:

The company was incorporated Feb. 27, 1889, to build a railway running from Cedar Point, Ala., north to the Tennessee State line. The State of Alabama has subsidized the road to the amount of $19,000. The locating surveys have been made and show a very favorable route. The principal business of the road will be in coal, timber, cotton, and farm produce. The estimated earnings of the road are $1,773,600, from which will be taken $1,520,000 for operating expenses, taxes, etc., leaving a balance of $253,000. C. C. MERRICK, Union Building, Chicago, Ill., is President.

Hiawassee, Iron, Mineral & R. R. Co.—This company has been organized in Tennessee to build a line of railway from Dayton to Hiawassee Gap, a distance of 32 miles. JOHN G. CARTER, Dayton, Tenn., is interested.

Middleburg, Highland & Lake Butler.—The officers of this company, which proposes to build a railway from Middleburg to Lake Butler, a distance of 20 miles, are: J. A. BRYAN, President; H. CLARK, Treasurer, and C. E. PICKETT, Superintendent; all of Jacksonville, Fla.

Greenwood & Tallahatchie.—A project is on foot to build a line of railway from Cassidy bayou down the Tallahatchie river, to Greenwood, Miss.

West Florida & Alabama.—This company has been organized in Florida with the following officers: J. D. PIRRONG, President; B. F. HOWLAND, Vice-President; and J. H. HAMILTON, Secretary, all of St. Andrews' Bay.

THE NORTHWEST.—Existing Roads.

Chicago, Milwakee & St. Paul.—This company has filed a mortgage for $150,000,000 secured by a first lien on all the company's property. The bonds bear 4 per cent. interest and will be used mainly to retire all the outstanding 5, 6 and 7 per cent. bonds now held on various portions of the company's property. $6,000,000 of these new bonds have been sold to Kuhn, Loeb & Co., of New York.

Northern Pacific.—Work is in progress on the connecting link between the terminus of this company's system and the lines of the Wisconsin Central R. R. at Ashland, Wis.

Kansas City, Wyandotte & Northwestern.—The Kansas City & Beatrice Railway Co. has been incorporated in the interest of this company, to build a railway from the south line of Pawnee county, Neb., through the counties of Pawnee and Gage to Beatrice, a distance of about 40 miles.

Projects and Surveys.

Grand Trunk Junction.—This company has been consolidated with the Polk & Forty-ninth St. Junction R. R., with principal offices at Chicago. The capital stock is $1,500,000. Among the directors are, JOSEPH HICKSON, W. J. SPICER, and G. B. REEVE.

Duluth, Milbank, Huron & Chamberlain.—Incorporated in Dakota to build a line of railway from Morris, Minn., via Milbank, Clark, and Huron, to Chamberlain, Dak., a distance of about 225 miles. Among the incorporators are, D. W. DIGGS, of Milbank, W. H. LAMB, of Clark, and J. O. STEARNS, of Chamberlain The principal offices will be at Milbank, Dak.

Black River Falls & Eastern.—The town of Black River Falls, Wis., has voted $10,000 in aid of this road, which is projected to run from Black River Falls to a connection with the Green Bay, Winona & St. Paul R.R., a distance of 23 miles. HUGH H. PRICE, of Black River Falls, is President.

Indianapolis, Beardstown & Quincy.—Incorporated in Illinois to build a line of railway from a connection with the extension of the Indianapolis, Decatur & Western at Beardstown, Ill., to Quincy, Ill., a distance of about 40 miles. Among the incorporators are, JOHN M. SAVIN, WM. W. BERRY, and R. F. NEWCOMBE, all of Quincy.

THE SOUTHWEST.—Existing Roads.

New Mexico.—A correspondent sends us the following:

Several parties of engineers supposed to be in the employ of the St. Louis & San Francisco, the Ft. Worth & Denver City and the Chicago, Rock Island & Pacific railway companies are now working through the southeastern corner of New Mexico Territory, evidently prospecting for the most feasible route to El Paso, Tex., and the southwest. The route being followed will take them through the fertile lands of Pecos Valley just north of the Texas State line. This region is just being brought under cultivation by the Pecos Irrigation Co., which has let contracts amounting to over $500,000 for the construction of canals to irrigate 200,000 acres of land owned by them. W. C. Bradbury, of Colorado, is the contractor and now has a large force of men and teams at work. The lines now being surveyed pass just south of the Guadelupe mountains, which route will give much lighter grades and cheaper construction than lines formerly run through the Guaro cañon and the passes of the San Francisco mountains.

ROCKY MT. AND PAC.—Existing Roads.

Rio Grande Western.—A press despatch quotes General Superintendent D. C. DODGE as saying that this company expects to build about 75 miles of practically new line and to make several other improvements during the present season. One section between Crevasse Station and Cisco Station, Col., about 40 miles long, will be entirely new. The road will be shortened about 16 miles in all. The cost for grading will be about $600,000 and the cost for rails to be used in changing the track to standard gauge will be about $1,000,000. Contracts will soon be let for the construction of 35 new engines and 600 new cars at a cost of $700,000 or $800,000. It is probable that the broad-gauge line from Grand Junction to Newcastle will also be built.

Denver & Rio Grande.—About 11 miles of track remain to be laid on the branch from Sapinero to Lake City, Col., a distance of 36 miles. The grading has been nearly completed on the line from New Castle to Rifle creek, and tracklaying will soon begin.

Union Pacific.—The articles of consolidation of the Oregon Short Line, the Utah & Nevada, the Utah & Northern, the Utah Central, the Salt Lake & Western, the Idaho Central, the Ogden & Syracuse, and the Nevada Pacific railway companies have been drawn up. They provide for the consolidation of these eight corporations with all their properties and franchises of every nature and description, into one corporate organization to be known as the Oregon Short Line & Utah Northern Railway Co. The capital stock is to be $24,789,039 which shall be issued in place of the stock of the separate companies. The cost of construction of the consolidated road is about $56,500,000, and the aggregate length is about 2,224 miles now and to be constructed.—It is stated that a party of engineers is making surveys, in the interest of this company, for a branch to run from Sidney, Neb., on the main line north, via Chadron, to the Black Hills.

Projects and Surveys.

La Jura, Pagosa Springs & Western.—We have received the following information from J. W. SCHIFFER, of La Jara, Conejos county, Colo., President:

The surveys for this road, which is to run from La Jara west through the Alamosa canon and the towns of Jasper and Stunner to Pagosa Springs, a distance of about 80 miles, are in progress and completed for about 40 miles. All except about 20 miles is mountain work. The maximum grade is about 2 per cent. as far as surveyed. There will be no bridges; possibly one tunnel. The principal business will be in ore, lumber, coal and the passenger traffic to the Pagosa mineral springs. About 40 miles right-of-way has been secured and local aid sufficient to make the surveys. The company was incorporated May 9, 1889. R. R. SALTER of La Jara, is Chief Engineer.

FOREIGN.

Cordova & Northwestern.—This is the name of a company which has been formed for the purpose of acquiring certain concessions granted by the Government of Cordova for the construction of a line of railway from the city of Cordova, in the Argentine Republic, to Crus del Eje, with branches from near La Calera to Las Centeras de Mal Paso, and from near Santa Maria to Tauti Cuchi, a total distance of 100 miles. The preliminary surveys have been made, giving a favorable route. The line runs through a fertile country, well adapted to growing the vine and rich in minerals. At Saladen and La Calera there are large quarries of marble used in making Cordova lime. The Government has subsidized the road to the amount of $35,500 per kilometer to be paid half yearly and to commence as soon as 25 kilometers have been opened for traffic. All the property of the company is exempt from taxation. The concession lasts 55 years from the date of the completion of the road, after which time all the property of the company becomes the property of the Provincial Government. The engineer of the company is ALFRED RUMBALL, 20 Victoria St., Westminster, London.

China.—It is stated that the Chinese Government will soon call for tenders for the construction of a railway from Pekin to Hankow, China.

Monterey & Mexican Gulf.—About 50 miles of this road, from Monterey southeast towards Tampico, Mex., has been completed and is in operation, and construction is being pushed on the remainder of the line. WM. H. WENTWORTH, of Monterey, is Chief Engineer.

Champerico & Northern.—This road, which runs from the port of Champerico, Guatemala, to the town of Retalhulea, a distance of 30 miles, has been sold to capitalists of Guatemala, and will, it is said, be extended by them. This company was incorporated in 1883 at San Francisco, Cal., and the road has been owned and operated by THOS. BELL and other capitalists of that city.

Sonora, Sinoloa & Chihuahua.—It is stated that work will be commenced soon by the contractors Huse & Co., of Chicago, on the line from Deming, New Mex., to Casto Grande, Mex., 145 miles.

RAPID TRANSIT.

Electric Railways.—***Salem, Mass.***—The ESSEX Electric Street Ry. Co. has been organized to build a line between Salem and Peabody. It is expected to have the line in operation by September. Treasurer, WM. D. DENNIS. Capital stock, $50,000.

Chattanooga, Tenn.—The contract for the extension of the electric railway has been let to Mr. EATON.

Columbus, O.—Work has been commenced on the new electric railway to Glassboro.

Cleveland, O.—The Board of Improvements has reported in favor of granting the Broadway & Newburg Street Ry. Co. an ordinance giving it the right to operate its line by electricity, and extending its franchise for 25 years.

Denver, Col.—The Denver Tramway Co. has received the required subsidy of $20,000, and will build a line from Alameda Ave., the terminus of the cable line, to Sheridan Ave., a distance of 4 miles. The road will be narrow gauge, and an overhead wire system will be adopted.

Electric Motors.—The Westinghouse Electric Co. expects to have its new motor, on the Tesla system, in operation by September. An overhead wire will be used with this motor, but the machinery is said to be very simple and powerful.

Elevated Railways.—***Greenpoint, N. Y.***—An elevated road is projected from the Newtown creek bridge to Myrtle Ave., Brooklyn. It will be in the interest of the Kings County Elevated Ry. Co.

Kansas City, Kan.—The Interstate Elevated Ry. Co. has applied for an amendment of its franchise to permit the use of steam locomotives instead of a cable on the new Riverview line, as the construction of the Kensington dummy line will form a loop with the Riverview line.

Dummy Line.—***Rome, Ga.***—The Rome Land Co. has purchased the dummy line built and owned by Capt. J. J. SEAY.

Cable Railways.—***Providence, R. I.***—The Providence Cable Tramway Co. has been asked to extend its line to Silver Lake.

St. Paul, Minn.—The Seventh St. cable line was formally opened June 15. It is 5½ miles long.

Street Railways.—***Brooklyn, N. Y.***—The Brooklyn City Ry. Co. proposes to extend its Flushing Ave. line to the county boundary.

Flushing, N. Y.—The Flushing & College Point Street Ry. Co. purposes to begin operation about August. The track is almost completed. President, JOSEPH DYKES; Treasurer, HENRY CLEMENT; Secretary, C. FREY.

Memphis, Tenn.—The Citizens' Street Ry. Co. has sold its franchises and property to a syndicate headed by Mr. HOLMES of Chicago, for about $950,000.

Fulton, Ill.—The Fulton & East Clinton Street Ry. Co. has been incorporated by JOHN C. MARTINDALE T. A. HARDIN and CHAS. A. GRISWOLD. Capital stock, $50,000.

CONTRACTING.

Dredging.—The following bids for dredging 25,000 cu. yds. from the Wallabout and Whitney basin, at the Brooklyn Navy yard, were opened June 15, at the Navy Department, Washington, D. C.: Wm. H. Beard, Brooklyn, 27 cts. per cu. yd.; Chas. Dubois, Brooklyn, 32 cts.; Brainard Bros., New York, 35 cts.

Sewers.—***Middletown, N. Y.***—The contracts for sewers have been awarded by CARROLL PH. BASSETT, Constructing Engineer, to B. Van Vranken, of Schenectady, and Jas. Dual, of Brooklyn, at the following prices; 8-in. pipe sewer, 70, 77 and 80 cts. per ft.; 9-in., 82 and 98 cts.; 10-in., 80 and 97 cts., 12-in., $1.20; Ys, 70, 75 and 90 cts. each, iron, 3 cts. per lb.; manholes, $2.95 per ft.; 6-in. house connections, 45 and 50 cts. per ft.; timber $30 per 1,000 ft. B. M.; rock excavation, $5 per cu. yd. concrete, $6 per cu. yd. The other bidders were J. W. Hamilton, of Middletown; C. J. Everson, of Middletown; C. A. Van Keuren, of Jersey City, N. J. The work is in 5 sections, aggregating 13,555 ft. of pipe sewers.

Bradford, Pa.—Coutracts have been awarded as follows by JOHN A. SEYMOUR, City Engineer: Kelly & Sheehan, of Bradford, for trunk sewers, 33 cts. per cu. yd, for excavation and back filling, $35 for manholes, $3 per cu. yd. for rubble masonry in cement, $7 for flushing gate, hinges, etc.; $11 for timber and plank; salt glazed sewer-pipe, $1.15 for 24-in., 78 cts. for 20-in., 44 cts. for 15-in.; 30 cts. for 12-in., 28 cts. for 10-in., 25 cts. for 8-in., $3.80 for 20 x 8-in. Ys, $2 for 10 x 15-in., and 8 x 15-in. Ys. J. C. Carr, of Bradford, for local sewers: 26 cts. per cu. yd. for excavation and back filling, 28 cts. per ft. for 12-in. salt glazed sewer pipe, 21 cts. for 10-in. 15 cts. for 8-in., $1.30 for 12-in. branches, $1 for 10-in., 68 cts. for 8-in., $27 for manholes.

Albany, N. Y.—Contracts have been awarded as follows: Delaware Ave. pipe sewer: A. N. Brady, $1.17 per lin. ft. for 18-in., 97 for 15-in., 85 cts. for 12 in.; $3.75, $3 and $2.40 for Ys; manholes, $50; lampholes, $10; receiving basins, $77.50 Elk and Second St. pipe sewers, W. E. Murphy, $1.05 for 15-in., 55 cts. for 6-in., $3.40 for branches; manholes, $40 and $60; lampholes, $12; receiving basins, $80.

Sewer Pipe.—The contract for pipe for the new sewers at Butte, Mont., has been awarded to the Butte Sewer Pipe & Tile Co. for about $20,000.

Street Work.—***Albany N. Y.***—The contract for granite block paving on Trinity place has been awarded to P. H. Reily: granite, $2.79 per sq. yd.; curb, 79 cts. per ft.; circular curb, 99 cts.; old curb, 5 cts. per. ft.; crosswalks, 10 cts. per. sq. ft.

Bradford, Pa.—A contract for paving has been awarded by J. A. SEYMOUR, City Engineer, to J. & M. McMahon: 33 cts. per cu. yd. for earth excavation, in-

cluding hauling and grading; 48 cts. per. lin. ft. for straight and curved curbing; $1.60 per sq. yd. for brick pavement, including sand and gravel ballast; 30 cts. per ft. for 8-in. sewer pipe, laid; $3 for setting sewer catch basins and connecting with sewers, $3.50 per cu. yd. for rubble masonry in cement.

Breakwater.-Proposals for the construction of the Marquette breakwater have been received by Major QUINN, U. S. Engineer Office, Duluth, Minn.: Powell & Mitchell, Marquette, Mich., $120.42 per lin. ft. for substructure, 24 ft., $19.74 per lin. ft. for superstructure; total estimate, $25,228.80. Morrison & Hannah, Duluth, $92.90 for substructure and $17.10 for superstructure; total estimate $19,800. J. Munro, St. Ignace, Mich., informal. The balance available for harbor improvements at Marquette will be $32,593.34. The extension is to be 180 ft. long. There will be three cribs 60x24x18½ ft., standing on a continuous substructure 180x24x6 ft. The average depth of the water where the extension is to be made is 32 ft. The contract calls for 99,062 ft. of timber, 158.77 cords of stone, and 8,764.1 lbs. of iron.

Hauling Stone.—The Selectmen of East Hartford, Conn., have received the following bids for carting stone from the railroad tracks to any point within a half mile on the roads: W. A. Wright, 22 cts. per ton; G. D. Burnham, 27½ cts; R. Devitt, 30 cts; Elmer & Arnold, 30 cts.; A. Burnham, 40 cts. The contract was awarded to W. A. Wright.

Wrought Iron Pipe.—The following bids for wrought-iron water pipe, 49 ft. long, 3 ft. diameter, at railway crossing, have been received by J. WHITELAW, Superintendent of Water-Works, Cleveland, O.: Smith & Teachout, Cleveland, $639; D. Connolly, Cleveland, $664.

Granite.—The following bids for cut granite for the Congressional Library have been received by B. GREEN, Superintendent, Washington, D. C.: Mount Waldo Granite Works, Frankfort, Me., $65,000; Booth Bros. & Hurricane Isle Granite Co., $72,113 and $65,336.55; Cape Ann Granite Co., Boston, Mass., $59,859; Gill & Johnson, Baltimore, Md., $52,968.90; George M. Wheelon & John Sheelds, Deer Isle, Me., $68,751.70; Cyrus J. Hall, Belfast, Me., $58,131; Southern Granite Co., Atlanta, Ga., $62,108.10.

City Hall.—The City Hall Commissioners, Syracuse, N. Y., have awarded the contract for the new building to Hughes Bros., at $238,750. Onondaga gray limestone will be used.

Asphalt Paving.—The Board of Public Works, Detroit, Mich., has received the following bids for Trinidad asphalt paving on Cass Ave.: Western Paving & Supply Co., of Chicago, $63,652.40; Warren-Scharf Asphalt Paving Co., of New York, $74,982.05.

Street Material.—The city authorities of Louisville, Ky., have awarded a contract for 30,000 tons of granite blocks, 10,000 lin. ft. of granite curbing, and 50,000 lin. ft. of granite flagging for gutters. Representatives of 25 of the leading granite companies of the country were present at the opening of the bids. All the bids were lower than heretofore made, the last granite purchased by the city costing $8.65 per ton. The award was made to the Mount Poney Quarry Co., of Culpepper county, Va., at $6.90 per ton for Virginia granite. The Maine and New Hampshire granite was offered at $7.40, Georgia at $7.43, and Arkansas at $7.83 per ton.

Cedar Block Paving.—The City Council of Des Moines, Ia., has contracted for several miles of paving at $1.24 per sq. yd. for cedar blocks on plank foundation, $1.54 for cedar blocks on concrete foundation, and $1.75 per sq. yd. for brick.

Gas Well.—The contract for boring the gas well at Hastings, Neb., has been let to Page Guthrie, of Pittsburg, Pa. The contract is for 50,000 ft. or less, at the option of the stockholders. Work is to be commenced by June 10.

River Work.—S. J. Truax, of Hastings, Minn., has been awarded the government contract, amounting to $65,000, for work to be done at the head of Lake Pepin in straightening and cleaning the river channel.

Jail.—A new jail is to be built next October at Marianna, Ark. For particulars address W. T. DERRICK, Clerk of Lee Co., Marianna, Ark.

Road Work.—The Board of Freeholders of Union Co. at Elizabeth, N. J., will issue $150,000 in 4½ per cent. bonds, for the improvement of the principal roads of the county.

PROPOSALS OPEN.

Water Pipe.—Approximately 522 tons 48-in. with 6 tons of special castings; 3,450 tons 49-in. with 84 tons of special castings. A. VAN DER VEER, President, Special Water Commission, Albany, N. Y.

Gas Lighting.—Capitol of the Province of Pernambuco, Brazil. A. DA COSTA, Secretary, Brazilian Legation, 24 State St., New York City.

Artesian Well.—Address W. R. MILLER, City Auditor, Groton, South Dakota.

Water-Works.—City of Plainfield, N. J. O. B. LEONARD, City Clerk.

Street Improvements.—Regulating, paving and grading streets. THOMAS F. GILROY, Commissioner of Public Works, New York City. July 2.

Sewers.—Laying about 1,500 ft. of 22-in. and 24-in. vitrified sewer pipe, excavation from 12½ ft. to 25 ft. deep, lower half in rock; also 14 manholes and 6 silt basins. CHAS. E. FOWLER, Superintendent of Water-Works and Sewers, Poughkeepsie, N. Y. July 2.

Sewers.—About 6 miles of pipe sewers. THE ROAD COMMISSIONERS, Ware, Mass. July 2.

Electric Lighting.—Furnishing, operating and maintaining 1,346 lights. HUGH J. GRANT, Mayor, New York City. July 2.

Sewers.—Brick intercepting sewers. H. W. WELCH, Clinton, Mass. July 5.

Dredging.—At the bulkhead, between Perry and West Eleventh streets, North river. COMMISSIONERS OF THE DEPARTMENT OF DOCKS, New York City. July 8.

Cementing.—Cellar floor, Naval Home. JAS. FULTON, Paymaster-General, U. S. Navy, Washington, D. C. July 9.

Storage Reservoir.—On the Muscoot branch of the Croton river, in the town of Somers, Westchester county, near Amawalk. THOMAS F. GILROY, Commissioner of Public Works, New York City July 12.

Street Improvement.—Elizabeth St. from Shillito to Union St., in Avondale, O. W. E. WYNNE, Room 39, Sinton Building, Cincinnati, O. July 15.

Steam Engine.—Fifty horse-power, automatic steam engine. GORDON E. COLE, 384 Jackson St., St. Paul, Minn. July 18.

Wreckage Removing.—Two schooners from Cambridge Harbor, Md. W. F. SMITH, U. S. Agent, Wilmington, Del. July 18.

Sewer.—H. M. FARNSWORTH, Room 12, 210 Superior St., Cleveland, O. July 23.

MANUFACTURING AND TECHNICAL.

Rolling Mills.—The new Montreal Rolling Mills Co. has begun the erection of its new building at St. Henri, Que. The company has acquired there 140,000 ft. of land, and the buildings, which will be 200 x 120 ft., will cost between $25,000 and $30,000. Twenty years' exemption from taxation has been granted. Wrought iron pipe will be a specialty.

Cement Pipe.—W. M. FRENCH, of Tavares, Fla., will erect a plant for the manufacture of cement pipe.

Artificial Stone.—The Jackson Artificial Stone Work Co. has been organized at Jackson, Tenn., by R. H. HAMMERSLY, G. H. RAMEY, and others.

Road Roller.—The city of Kingston, N. Y., has purchased a steam roller from the Harrisburg Car & Mfg. Co., Harrisburg, Pa.

Signals.—The Universal Electric Railway Signal Co. has been incorporated at Richmond, Va. President, ROBERT G. CORBELL; Secretary, JAMES R. BRAND.

Docks.—The South Brunswick Harbor & Land Co. will expend $1,000,000 on docks, wharves, etc.

Rock Drilling.—The Rand Drill Co., of New York, has received the following letter:

The following work, done with one of your No. 4 Little Giant rock drills, will certainly be interesting to you. A certain party wagered $10 with me that I could not bore 130 ft. in one day's work of 10 hours in hard New York rock. I was working then on the northwest corner of Fiftieth St. and Third Ave., this city. I took the bet up, and on Wednesday, April 17, 1889, I drilled 25 holes, each hole being 5¼ ft. deep and 2¼ ins. at the bottom, making thus a total of 137½ ft., the wager being won with 7½ ft. to spare. The holes were measured by me and the party I wagered with and the contractor for for whom I was doing the drilling.

The Brass & Iron Works Co., organized at Fostoria, O., carries on the business of the firm of Walter S. Payne & Co., Mr. W. S. PAYNE having withdrawn from the firm. President, CHARLES FOSTER; Manager, NICHOLAS PORTZ; Secretary, WM. M. DAY; Superintendent, J. C. TITUS.

Die Forgings.—The Springfield Iron Works, of Springfield, Mass., make a specialty of die forgings, and have put in a new plant for this class of work, using dies under heavy pressure instead of hand hammers, by which means all pieces of the same form are exact duplicates. A circular is issued giving illustrations of some of the different forms of forgings made, and is of interest to architects, builders, master mechanics, etc.

Brake.—The Solano Air Brake Co. has been incorporated at Chicago, Ill., by L. G. FISHER, D. J. SCHUYLER, and F. ULLMAN. Capital stock, $1,000,000.

Pumps.—The Ward Pump Co. has been organized at Rockport, Ill., by F. WARD and F. LANE. Capital stock, $50,000.

The American Sanitary Co. has been organized at Covington, Ky., by H. N. LEWIS, GEO. B. KERPER, CHAS. LUDLOW, E. O. ELHELBY, and E. R. DONOHUE. Capital stock, $150,000. The company will manufacture and deal in sanitary appliances.

Construction Companies.—The Inland Construction Co. has been incorporated at Tacoma, W. T., by W. H. WOODRUFF, T. L. NIXON, and HY. DRUM. Capital stock, $250,000.

The Lake Erie Construction Co., of Sandusky, O., has been incorporated at Columbus.

Car Heating.—The McElroy Car Heating Co., of Detroit, Mich., and the Sewall Car Heating Co., of Portland, Me., have been consolidated. Together they control 100 patents and have applications for 100 more pending. The capital of the new company will be $2,500,000. ROBERT C. PRUYN, of Albany, N. Y., is President and S. HATCH, of New York, is Vice-President.

Creosote Works.—The Puget Sound Creosote Co. has been incorpated at Seattle, W. T., with a capital stock of $250,000, by T. T. MINOR, A. M. BROOKS, W. R. FORREST, EUGENE RICKSECKER, and C. H. KITTINGER. The objects of the corporation, as set forth in the articles, are to manufacture wood creosote oil, charcoal, lamp black, and disinfectants, to char or carbonize wood or timber, to impregnate wood, timber, and lumber with creosote oil, and to carry on the general business of a creosoting and timber preserving company.

Filters.—The National Water Purifying Co., of Philadelphia, Pa., reports that Mather & Platt of the Salford Iron Works, Manchester, England, have completed negotiations whereby they will introduce the National filter into Great Britain and Europe for manufacturing and water-works services.

BRIDGES AND CANALS.

Bradford, Pa.—The following proposals for masonry and iron superstructure were opened, June 17, by JOHN A. SEYMOUR, City Engineer. The bridge is 80-ft. clear span, with 18-ft. roadway, and two 6-ft. sidewalks. Masonry:—Briggs, of Bradford, $7 per cu. yd. for 253 cu. yds. of masonry, 40 cts. per cu. yd. for 700 cu. yds. of excavation, $40 for removing old bridge, etc., total $1,955;—Palmer, Stroudsburg, $6.94, 44 cts., $40, $1,978.90; J. & M. McMahon, Bradford, $6.10, 60 cts., $200, $2,053.50. Superstructure: Berlin Iron Bridge Co., East Berlin, Conn., $2,287, $1,877; Dean & Westbrook, New York, $2,300, $2,460; Smith Bridge Co., Toledo, O., $19,95; per ft., total $1,695.75; Variety Bridge Co., Cleveland, O., $1,835; Champion Bridge Co., Wilmington, O., $2,300; King Iron Bridge & Mfg. Co., Cleveland, O., $2,230, $1,837; Penn Bridge Co., Beaver Falls, Pa., $2,449, $2,012; Wrought Iron Bridge Co., Canton, O., $2,150, $2,227, $2,400, $2,640; Mt. Vernon Bridge Co., Mt. Vernon, O., $2,386, $2,621.

Fort Riley, Kan.—Proposals are invited by the United States Government for the construction of an iron or steel bridge across the Kansas river at Fort Riley, Kan. The bridge will consist of a main span of 250 ft., center to center of end pins, resting on iron tubular piers, and an approach span of 80 ft., center to center of bearings, one end of which will rest on the iron piers under the north end of the main span, and the other on a masonry abutment. The spans will be level, but the roadway will be on a grade of 5 per cent., the head room to be not less than 15 ft. The width of the roadway to be 18 ft. The main span will be a pin-connected truss, with parallel chords of any of the standard types, and the approach span may be either pin-connected, or built as a plate or lattice girder. This span will be located over the tracks of the Union Pacific Ry. The superstructure will be of iron or steel throughout, excepting roadway floor and joists, guard rails, etc. Capt. GEO. E. POND is Asst. Quartermaster; W. H. STAIR is the Civil Engineer of the Department.

Bridge Notes.—***Pierre, Dak.***—A franchise to build a pontoon bridge across the Missouri river has been granted to a company composed of local capitalists.

Denver, Colo.—It is proposed to replace the Larimer street bridge, over Cherry creek, with a more substantial structure. The City Cable Railway Co. has offered to contribute $3,000. The estimated cost is $25,000.

Rockville, Ind.—The Canton (O.) Iron Works have been awarded the contract to build a bridge across the Big Raccoon at $4,900. There were fifteen bidders.

Augusta, Me.—The city council is in favor of a new $40,000 iron bridge for that city.

Greensburg, Pa.—The Pittsburg Bridge Co. has been awarded contracts for part or all of the following work New bridges at New Florence, Nineveh, Blairsville, and Livermore, and for repairing bridges at Saltsburg, Cokeville, and Kelley's station.

Belleville, Mich.—A bill has passed the Legislature providing for the construction of bridges in this place.

Holyoke, Mass.—Ex-City Engineer MANN has presented a plan to the Committee of Highways and Bridges for a bridge on Dwight street, across the second level canal, calling for a stone arch bridge of three spans, varying from 42 ft. to 37 ft. in the clear. Estimated cost, $26,000 to $28,000. He has been instructed to furnish specifications for such a bridge. An ordinary railway bridge would cost about $21,000.

Louisiana, La.—The two bridges in Avoyelles parish, are to cost $23,000, to be paid in ten annual installments, beginning Feb. 1, 1890.

Memphis, Tenn.—The Kansas City, Fort Scott & Memphis R. R. Co. has secured a charter and formed the Kansas City & Memphis Ry. & Bridge Co., and will issue $2,500,000 of bonds to build a bridge across the Mississippi river at Memphis.

Augusta, Ga.—A resolution has been adopted by the Council to put in stone piers instead of wooden cribs, as is now being done. Bids will be opened for building them on June 24.

Baltimore, Md.—The mayor has signed an ordinance

appropriating $6,000 for the repair of the Wilkins Ave. bridge.

Parkersburg, W. Va.—The city is advertising for bids for an iron or steel bridge to be built across the Little Kanawha river at that point. The estimated cost is about $80,000. Address A. B. BECKWITH.

Brower's Mills, N. C.—Proposals will be received until July 13 for building a bridge across Deep river at Waddill's Ferry, by R. A. BREWER.

Lexington, Va.—Iron bridges are to be erected by the county authorities over Calf Pasture river at Goshen bridge, and over South river, near Riverside.

Chehalis, Wash. T.—The county commissioners have directed the auditor to advertise for bids for the construction of a new wagon bridge across the Cowlitz on the Klickitat road.

Idaho.—It is proposed to bridge the Snake river below Siarrhs' Ferry, near Great Shoshone Falls, in Cassia county. Logan county and the Union Pac. R. R. have offered $5,000 respectively toward the structure.

Frederick, Md.—The Board of County Commissioners has awarded contracts for replacing bridges as follows:—Bridge over the Monocacy, near Ceresville, two spans, 157 ft. in length each, 22-ft. roadway, to the Smith Bridge Co., Toledo, Ohio, for $11,200; bridge on the Georgetown pike, near Frederick junction, two spans, of 150 ft. each in length, 22-ft. roadway, to the King Iron Bridge & Mfg. Co., Cleveland, O., for $10,780; bridge near Buckeystown, two spans, 137 ft. each in length, 16-ft. roadway, to the Canton Bridge Co., Canton, Ohio, for $7,500; bridge at Shell's fording, two spans, 148 ft. each, 16-ft. roadway, to the Columbia Bridge Co., Dayton, Ohio, $9,060; bridge at Greenfield mills, two spans, of 130 ft. each, 16-ft. roadway, to Dean & Westbrook, New York city, for $7,100; bridge near Creagerstown, two spans of 128 ft. each, 16-ft. roadway, to the King Iron Bridge & Mfg. Co., Cleveland, Ohio, for $6,870; bridge at Miller's, two spans, of 107 ft. each in length, 16-ft. roadway, to the Groton Bridge & Mfg. Co., Groton, N. Y., for $14,370. The contracts for mason work on the bridges have been awarded mainly to Frederick mechanics. The latter work will cost in the aggregate about $20,000. The total cost of the new bridges will be about $75,000.

Kansas City, Kan.—Plans for the Tenth street bridge over Kansas Ave. have been prepared by the city engineer. Estimated cost, $10,000.

Fort Smith, Ark.—Work on a bridge to span the Arkansas river is to be begun within sixty days.

Los Angeles, Cal.—A bridge is to be built across the San Gabriel river at El Monte. Address the Board of Supervision.

La Crosse, Wis.—The Common Council has definitely settled upon an iron drawbridge in preference to either a pontoon or high bridge.

Gallatin, Tenn.—Address the Mayor for particulars regarding a proposed iron bridge.

Duxbury, Mass.—The county commissioners are making investigations and taking steps toward constructing a bridge from Powder Point to Salt House beach.

Wheeling, W. Va.—The people recently voted on a loan, part of it to be spent in building a stone bridge over the creek at Main street to replace the one destroyed by last August's flood. The indications are that the loan will be defeated, an iron bridge being generally considered good enough.

Alton, Ill.—Engineer SWIFT and party are making surveys and plans for a new iron bridge for the Bluff line at Hagaman. The same will be done near Chesterfield, where the wooden bridge over Macoupin Creek will be replaced by an iron one. The Chicago & Alton running its tracks at the edge of the river bank between these two places, will necessitate trestling the entire distance, requiring 375,000 ft. of timber.

Canals.—*Paterson, N. J.*—The citizens have pledged the funds necessary to continue the fight in the courts of New Jersey to compel the Dundee company to reopen its canal, which it was given the privilege of constructing in 1857, on the plea that it was for the purpose of opening navigation from the lower Passaic river to Paterson.

Chesapeake & Ohio.—At a meeting of the stockholders at Annapolis, Md., June 13, resolutions were passed authorizing the issue of repair bonds. The amount required is estimated at $300,000. They will be secured by a lien upon the canal bond. President STEPHEN GAMBRILL and all of the old Board of Directors were reëlected.

ELECTRICAL.

Electric Lighting in South America.—*Maracaibo, Venezuela.*—The Maracaibo Electric Light Co. has been incorporated at Albany, N. Y., by FRANCISCO POTO VILLAMIZAR, SANTIAGO PEREZ TRIANA, RAFAEL FIDEAU, ALBERT M. FUENTES, JULIO C. PONCE DE LEON, and DAMASO MAZENET, of New York, and JAMIE F. CARRILLO, of Maracaibo, Venezuela, to manufacture gas from coal, kerosene oil, etc., and to light by gas or electricity the city of Maracaibo, or any other city or town in the Republic.

La Plata, Argentine Republic.—The River Plate Electricity Co. has been organized at Buenos Ayres, in the interest of the River Plate Loan, Trust & Agency Co., to carry on an electric lighting business in the Republic, and will commence operations at La Plata. Capital stock, $2,500,000.

The Southern Electrical Mfg. & Supply Co. has been incorporated at New Orleans, La., by SAMUEL LOGAN F. A. PATTISON, CHARLES CARROLL, C. EDMOND KELLS, Jr., and GEO. K. PRATT. Capital stock, $50,000.

Electric Light.—*Frankfort, N. Y.*—The Frankfort Electric Light Co. has been incorporated by F. C. EATON, of Utica, and others. Capital stock, $6,000.

West Point, Miss.—Mr. J. S. KENNEDY, Mayor, wants propositions for putting in an electric light plant.

Winterset, Ia.—The electric light question is being agitated. It is proposed that the city put in the plant and operate it. The City Council appointed a committee to visit the neighboring cities and investigate the different systems. The committee visited Knoxville, Pella, Oskaloosa, and Des Moines, and made a thorough examination of the plants at those places.

Owatonna, Minn.—The Electric Light Co. will put in a plant if the city builds the proposed water-works and pumping plant.

Montrose, Col.—The Heisler Electric Light Co., of St. Louis, Mo., has put in a plant.

Helena, Mont.—The Helena Power & Lighting Co. will increase its capital stock from $50,000 to $200,000 and will extend its plant.

Houston, Tex.—A new company has completed its plant, and there are now two electric light companies in operation.

WATER AND MUNICIPAL.

Artesian Wells.—*Sandersville, Ga.*—It is proposed to sink a well for a water supply.

Darien, Ga.—LOUIS COLLAT is interested in a project to sink wells.

Key West, Fla.—The Key West Water Supply Co., of 5th and Locust Sts., St. Louis, Mo., is receiving bids for sinking an 8-in. well.

Monticello, Fla.—The County Commissioners will put down a well at a cost of $2,000.

Columbia, Ala.—The artesian well put down by Mr. HERRINGTON is about 500 ft. deep and supplies good water. It will be drilled deeper.

Temple, Tex.—The city has offered a bonus of $2,000 for an artesian well furnishing 150,000 galls. per day. For particulars address the mayor.

Filters.—In regard to the item on page 561 referring to a filter plant for Newburg, N. Y., we are informed that the Hyatt plant was only recommended by the Water Commissioners, and that no contract has been awarded, as the whole matter has been referred to the Finance Committee, who meet on July 2, and after their report is made, the whole case will have to be submitted to a popular vote as to which filter will be accepted.

Duluth, Minn.—The Board of Public Works has issued its report for the year ending Feb. 28, 1889. The work done during the year included 10 miles of grading, 1.5 miles of streets, 3.1 miles of storm water and 4.3 miles of sanitary sewers. Sewers from 15 to 24 ins. diameter are of vitrified pipe laid in a 6-in. bed of concrete; up to 32 ins. they are of Portland cement concrete formed in place in the trench. The main storm sewer, on First Ave., is 40 to 48 ins. diameter; the bottom is of granite, the sides of a special interlocking brick laid in Portland cement and backed with concrete, and the arch is of sewer brick. A street paving of round cedar blocks on concrete foundation has been adopted, the necessity of a permanent foundation having been recognized. WM. B. FULLER is City Engineer, and M. W. LEWIS, Assistant Engineer.

Portland, Ore.—Superintendent I. W. SMITH has presented his report on the proposition to increase the capacity of the water-works to 10,000,000 galls. per day. There are now two 5,000,000 galls. pumps and a force main, which, by the addition of a half mile of pipes within the city limits, will deliver 10,000,000 galls. a day to the distribution pipes. But the storage capacity of the reservoir is little more than 1,500,000 galls., and with a constant demand of 10,000,000 galls. a day, the supply will be interrupted whenever it may be necessary to repair the main or one of the pumps, or to clean out a boiler; and in view of the possible consequences of even a temporary interruption of the water supply, it will be necessary either to construct a reservoir with a capacity for two or three days' consumption, or to duplicate the pumps and force main from Palatine hill. The only site for a reservoir of sufficient capacity is in the City park, but as this is over 300 ft. above the city base, it would be necessary to pump the water into it from the low service reservoir to an elevation of 120 ft., and to connect the two reservoirs by means of a pipe not less than 24 ins. in diameter. But as this reservoir would be too high for the low service, it would be necessary in order to supply 10,000,000 galls. a day to lay a large pipe to the low-service reservoir and from that reservoir to the mains. For these reasons he is of opinion that the safest and most economical method of providing for a delivery of 10,000,000 galls. a day will be by means of a duplicate pump and force main from Palatine hill, and the purchase of a new pumping engine of 10,000,000 galls. daily capacity is recommended. The total cost of this engine and for 4.55 miles of wrought-iron and .75 mile of cast-iron pipe, is estimated at $195,000. The Water Committee has adopted the report, and has directed the Superintendent to prepare specifications for the work and submit them to the Committee so that proposals can be advertised for.

Water-Works.—*New Hampshire.*—Dover. The City Council has established the salary of the Board of Water Commissioners at $1,500.

Vermont.—Barton. The construction of a system of water-works is being discussed. Address the City Clerk. ——Richford. A gravity system, to cost about $18,000, with a 252-ft. head, was begun in May and will be completed in July. The supply will be taken from springs and conveyed to a reservoir. Size of mains, 10 to 4-in. cast-iron. Hydrants, 29. Valves 22.

Massachusetts.—Holyoke. At the annual meeting of the Water Power Co., J. B. STEBBINS was re-elected President; E. S. WATERS, Treasurer and Clerk. A semi-annual dividend of 5 per cent. was declared.——Boston. An inspection of the Sudbury, Framingham and Hopkinton systems has been recently made by the Water Commissioners and Engineers. A committee will report in July on the building of basin No. 5, and a dam, and on making improvements at a cost of about $1,200,000. The expenditure of this amount, it is said, would render Boston's water supply adequate for a quarter of a century.

Connecticut.—Thompsonville. The water company is extending its mains through Enfield St. A new standpipe will be located at its lower end.——New Britain. A new water main is to be laid in Washington St.——Bristol. Water-works have been completed.

New York.—Watkins. Gov. HILL has signed a bill amending the charter, which will allow the town to contract with any company for a system of water-works. ——Amsterdam. Prospecting is going on for an additional water supply. There is a strong sentiment in favor of tapping Hans creek——West Troy. The quality of the water is being complained of. The trouble is caused by the water coming from the old reservoir, instead of being pumped from the river.——Clyde. The water company's pump has been placed in position.——Syracuse. H. J. MOWRY has been elected President, and J. B BROOKS, Secretary, of the new Water Commission.—— Coney Island. Water will be supplied to the residents, through the new mains, this week.——Sandy Hill. The Spring Brook Water Co. has elected the following officers: President JOHN J. CUNNINGHAM; Treasurer, R. W. SHERMAN: Secretary, C. DEVINE.—— Medusa. During the recent storm the reservoir was reported to be leaking and unsafe. The water was drawn off.—— Cohoes. A new 10-in. main is to be laid through Oneida street.——Albany. The superintendent has been directed to purchase 12,000 ft. of 6-in pipe.——Olean. The annual report of the water commissioners shows the expenses of the water-works for the year to be $21,500. A new pump has been added, and the mains largely extended. The work will be self-sustaining in time. The receipts for water rents were $8,000.——Glens Falls. Dr. AMEDIN has been appointed to make an inspection of the reservoirs.——Otego. A certificate of organization of the Otego Water Company has been filed with the Secretary of State. The source of supply is the Otsdawa creek, in Otsego county. The capital is $22,000. The trustees are J. WARREN LAMB, GEORGE BROOK, MARCUS FIELD, LOTTIE A. FIELD, FANNIE C. LAMB, MARY L. BROOKS, ALICE BROOKS.——Brooklyn. The Board of Aldermen has appropriated $137,600 for improving the water-works. Ex-City Engineer VAN BUREN has recommended to the Aldermanic Water and Drainage Committee that the conduit it is proposed to build from Baldwin's pond to the Ridgewood engine house, a distance of 13¼ miles, be of 5-ft. iron pipe. It will then have a capacity of 40,000,000 galls. a day. The cost is estimated at $15,000,000.—— Hamburg. A land company is to be organized to put in water-works at a cost of $30,000. D. M. LOCKWOOD is interested.——Lansingburg. Engineer FRANKLIN's estimate of the work completed at the new reservoir has been received, and an audit made to Sherman & McDonough, the contractors.

New Jersey.—Newark. The Aqueduct Board has completed the draft of the contract between the city and the Lehigh Valley Railroad Company for a new water supply. It will be submitted to the council at its next meeting for approval.——Plainfield. Bids for the construction of water-works will be opened August 5. (See notice of proposals to be received in another column.) ——Jersey City. JOHN R. BARTLETT has agreed to supply the city with water at $20 per million gallon.

Pennsylvania.—Sewickley. The report of the Water Commissioners for 1888 shows that during the year 963 ft. of pipe were laid and two new fire plugs set.——Philadelphia. Quarantine Master NEWBOLD has entered complaint with the Health Board against the bad well water at the Lazaretto Station. A sample has been sent to Dr. CRESSON for analysis.

Maryland.—Baltimore. The committee on streets and public property have concluded that a supply of water must be furnished for the City park. The most feasible scheme seems to be to dig or drive a well, or

wells, and a contract for this work will probably be let soon.

District of Columbia.—Washington. The Osceola Water Co. has been organized. The officers are: FRANK HUME, President; FRANK L. HOOD, Vice-President; JAMES R. LUPTON, Secretary; JAMES L. BARBOUR, Treasurer.

No proposals for a bridge for taking the 48-in. main across Rock creek were received. Plans will be prepared for a truss of proper dimensions and proposals again invited at once.

Virginia.—Richmond. The Westmoreland Co., capital stock, $250,000, has been chartered to lay out a town one mile from Richmond and build water-works. Address Gen. BRADLEY T. JOHNSON, Baltimore, Md.——Roanoke. The water company and the gas company have been purchased by a syndicate, the former at $200,000, and the latter at $84,000, and have been merged into one company to be known as the Roanoke Water & Gas Co. The company is to supply light and water to the public, and to persons, partnerships and corporations. It will erect all necessary devices for the reception, conveyance, and distribution of light and water. The capital stock is placed at $500,000, with power to increase the same to $2,000,000, in shares of $100 each. President, FREDERICK J. KIMBALL; Secretary and Treasurer, H. E. GERHARD; Directors, CLARENCE H. CLARK, HAROLD M. SILL, PEYTON L. TERRY, HENRY S. TROUT, FREDERICK J. KIMBALL, JOSEPH H. SANDS, JOSEPH I. DORAN, CHARLES G. EDDY, A. S. ASBERRY, JOHN H. DURFEE, and JOSEPH J. MARTIN.

North Carolina.—Raleigh. A large filtering tank is being added to the city water-works.—— New Berne. The water-works are to be extended and improved.——Lincolntown. The city contemplates building water-works for fire protection and wants estimates by July 5. Address J. M. ROBERTS.——Goldsboro. Porter & Goodwin have the contract to build water-works.

South Carolina.—Rock Hill. The council is considering a proposition for the construction of water-works. The works will be constructed as soon as a proper system is decided upon.

Georgia.—Complaints have been made of the quality of water now being furnished by the Gas & Water Company. Surface water is being furnished to consumers instead of spring water as heretofore.——Waycross. A bill is to be introduced in the Georgia Legislature authorizing the issuance of bonds to build the water-works. The mayor can give particulars.——Athens. The Athens Water Co. will probably put in additional pumps.——Madison.——Atkinson Bros. have made a proposition to the city to construct water-works. ——Atlanta. The Chattahoochee river is said to be the best source from which to draw the proposed new water supply.

Florida.—Tallahassee. The contract to build water-works has been awarded to the American Pipe Mfg. Co., Philadelphia, Pa., by the Tallahassee Water Co.

Alabama.—Huntsville. The Monte Sano Water Co. has been organized and will erect water-works.——Spring Garden.—A water-works and improvement company has been organized. President, J. W. TUCKER. H. Merigold has the contract to lay 18 miles of pipe for the new water-works.——Montgomery. The Capital City Water Company has submitted to arbitration to determine what terms shall be agreed upon for the coming year.

Mississippi.—The Water Supply Company is to put in additional pumps.—— Meridian. The capacity of the pumping plant is to be doubled.

Tennessee.—Nashville. The city has sold $300,000 of 4 per cent. bonds.——New Berne. Arrangements are being made to build water-works.

Michigan.—Hastings. New works are contemplated. The old works are unsatisfactory.

Illinois.— Duquoin. Water-works are to be constructed. Address Chairman Water Committee.——Peoria. The water company is now looking for a pure water supply——Aledo. The city has contracted with the United States Wind Engine & Pump Co. for water-works.

Iowa.—Kingsley. A system of water-works is to be established.——Davenport. In the proposed extensions 600 tons of iron pipe will be used.

Minnesota.—Owatoma. Bonds for $30,000 for water-works have been voted.

Kansas.—Phillipsburg. Water-works are wanted.

Nebraska.— Lexington. Water-works are wanted. ——Pawnee City. The city has taken the works from the contractor and will complete them under its own supervision.——Lincoln. The new system of gang-wells has been connected.——Ogallala. A vote on the question of issuing bonds for $35,000 for water-works, will be taken July 23.——Fremont City. Bids are wanted for water-works to cost $35,000.

Wyoming.—Evanston. Water-works are to be built.

Montana.—Helena. The city will advertise for bids for a water supply.

Arkansas.—Batesville. Water-works will be built this season.

Texas.—Lockhart. The system will be extended.—— Laredo. Water-works will be built.——Temple. The contract for 6 miles of mains has been awarded to a St. Louis party.

Colorado.—Crested Butte. A gravity system of water-works is being talked of.

New Mexico.—Santa Fé. Storage reservoirs are to be built this season.

Oregon.—Ashland. Bonds for water-works to cost $50,000 have been voted. The city will build and own the works.

Washington Territory.—Spokane Falls. The new water-works have been inaugurated.——Tacoma. The water supply is said to be inadequate.

California.—Los Angeles. A new water company is to apply to the Council for the right to lay water mains.

Ontario.— Petrolia. Water-works are to be constructed.——Pictou. Work will be commenced at the new water-works soon.——Hamilton. At a six-hour test of the new pumping engine the gauge at the City Hall showed a pressure of 80 lbs.——Windsor. The new engine is being supplied by Kerr Bros., Walkerville.——Galt. A vote is soon to be taken on the question of building water-works.—— Collingwood. Bids for constructing a water-works system have been received by THOMAS BASSETT, Chairman of the Water-Works Committee. The lowest bid was made by McQuillan & Co., of Toronto.

British Columbia.—A vote in favor of issuing bonds for water-works has been carried. A. E. HILL is the engineer.

Special Reports of Water-Works.

Sullivan, Me.—CHAS. P. SIMPSON, one of the incorporators of the Sullivan Harbor Water Co., has given us the following:

A charter was granted to the company in 1889. It has been proposed to supply Sullivan Harbor and West Sullivan, which have a combined summer population of about 800. A partial supply is now obtained by collecting water in a tank from a large spring, and pumping it to tanks on higher ground. The new supply will probably be by gravity, from Long Pond. Estimated cost, $25,000. Address Sullivan Harbor Land Co., 95 Milk St., Boston, Mass.

Litchfield, Conn.—Preliminary surveys for water-works are being made by T. H. MCKENZIE, of Southington. Capital for construction has not yet been secured.

New Hartford, Conn.—Water-works are projected, and T. H. MCKENZIE, of Southington, is making preliminary surveys. Money to build the works has not been raised.

South Norwalk, Conn.—JACOB LAYTON, Secretary, informs us that they are thinking of building a dam between the two present ones, and connecting it with the new supply by an 18-in. main. Estimated cost, $50,000.

Amsterdam, N. Y.—A. H. DEGRAFF, Superintendent, writes that he is making surveys for a new supply of 5,000,000 galls. a day, from a brook 18 miles north of the town.

Brockport, N. Y.—JNO. N. DOLE has given the following:

Bids to supply the village with water for fire protection at a yearly rate not over $3,000 were to be received June 25. It is thought that the supply will be pumped from artesian wells to a stand-pipe. Population, 4,200.

Canton, N. Y.—J. H. MILL reports that the village was to vote on the water-works question June 22. The village will own the works.

Lansingburg, N. Y.—R. W. SHERMAN of Troy has sent the following:

The Troy Public Works Co., Limited (formerly Sherman and McDonough) is making extensions to the mains, and also constructing a new storage reservoir. The dam forming the reservoir is the third one built here by this company, and has the same general dimensions and character as the second, which was of clay and sand, had puddle core, inner slope of 3 to 1, outer of 2 to 1. The water at the dam is 20 ft. deep. Address D.H. RICE, Village President.

Silver Springs, N. Y.—W. H. CUMMINGS has sent us the following:

The Silver Springs Water Co. began the construction of works June 20, with Ayrault & Son, Tonawanda, N. Y., as contractors. The supply will be by gravity to a reservoir, from springs 1½ miles from, and 150 ft. above the village. Cost, $6,000. Population, 500.

Skaneateles, N. Y.—We are indebted to GEO. BARROW, President of the Skaneateles Water-Works Co., for the following:

The company is looking for a contractor to build the works, but also thinks of constructing the works itself. Water will be pumped from Skaneateles lake to a stand-pipe, at a cost of from $35,000 to $40,000, which has not been secured. The village has 400 buildings, a population of 2,200, and an assessed valuation of $1,200,000.

Mercer, Pa.—A new pump has been proposed.

Pittsburg, Pa.—The Pittsburg Water Co. report a proposed complete change in the works, to be effected by building a large storage reservoir.

Reynoldton, Pa.—JAS. ESCOFF, Superintendent McKeesport water-works has sent us the following:

The borough has made a 5-year's contract for water from the McKeesport works, for which they will pay $50 per 1,000,000 galls. An 8-in. main will be carried beneath the Youghiogheny river, and mains laid in Reynoldton. Contracts had not been let June 19, but it was expected that work would begin in July. Estimated cost, $20,000. At the expiration of the contract it is hoped that the village can erect a pumping-station and furnish its own supply. Address the Burgess of Reynoldton. Population, 1,500.

Scottdale, Pa.— The following is from HENRY TAYLOR, Secretary:

The Citizens' Water Co. has secured a charter, made a preliminary survey, and received $10,000 of subscriptions to stock. It is expected that construction will be started this summer, taking the supply by gravity from a mountain stream. Estimated cost, $6,000. The borough has a population of about 3,000, and in addition there will be a demand for water from outlying coke manufactories.

Goodson, Va.—Works are being built, with the Glamorgan Co., Lynchburg, Va., as contractors.

New Berne, N. C.—A. K. DENNISON has sent the following:

Mr. DENNISON has laid 3,000 ft. of 3-in. pipe from an artesian well for fire protection to his property and will lay an equal amount this season. Capital is needed to extend the plant over the town at once, but if not secured the extensions will be made gradually. Complete works would probably cost $100,000, and would include pumping machinery and a stand-pipe. Population, 7,000.

Cedartown, Ga.—The following is from ROBT. O. PITTS, City Clerk:

The result of the water-works election was that a private company will be allowed to build works, the town to have the privilege of buying them when completed. Bids will soon be desired. Population, 2,500.

Pulaski, Tenn.—The proposition for water-works was recently defeated by a vote of the town.

Shelbyville, Ky.— We are indebted to LYNN T. GRUBER for the following:

The town has voted for water-works, but the ownership has not been determined. The supply will be from an artesian, or a large open well. Estimated cost, $30,000. Population 3,500. Correspondence is wished, address LYNN T. GRUBER.

Bridgeport, O.—ROSS J. ALEXANDER has sent the following:

It is proposed to build works, connecting with those at Martin's Ferry, or at Wheeling, W. Va. Estimated cost, $25,000. Population, 4,000. Address GEO. S. MCKEE.

Marietta, O.—W. G. BARTHOLOMEW has given us the following:

The city will build works, probably pumping from the Ohio river. Estimated cost, $80,000. Engineer, JNO. W. HILL, Cincinnati, O. Address the City Clerk.

Wyandotte, Mich.—WM. CAMPBELL, Mayor, has sent the following:

The city has voted to issue bonds to build work, estimated to cost $50,000. Work will probably be started within a month. Water will be pumped from the Detroit river directly to the mains. Population, $4,500.

Buckley, Ill.—J. M. LIMBRINDGER informs us that small works will be built at once, by the village. Water will be pumped from well to tank at a cost of $800. Population, 500.

Pana, Ill.—W. R. COATS, Kalamazoo, Mich., has made plans and estimates for water-works, and submitted them to the village Council.

Aurora, Neb.—An extension of 2 or 3 miles has been proposed. The works have been in operation only since April 1.

Grant, Neb.—BEN. S. CLARKE is now laying 12,000 ft. of pipe and placing 15 hydrants for the Lincoln Land Co.

Tekamah, Neb.—E. B. ATKINSON, City Clerk, has given us the following:

An election will soon be held to vote on the issuance of $15,000 of 6 per cent., 5-year bonds. The vote will doubtless be favorable, and water-works, adequate to the wants of the town, will be constructed this year.

Holyoke, Col.—The Lincoln Land Co. has let the contract for 254,000 ft. of pipe-laying, with hydrants and specials, to BEN. S. CLARKE. Work was begun June 26.

Albert Lea, Minn.—F. A. JOHNSON has sent the following:

The town is ready to receive propositions from private companies to build water-works. The supply would probably be from artesian wells, and the cost is estimated at from $25,000 to $40,000. Population, 4,000. Address Alderman W. A. MORIN.

Swept Away.

JOHNSTOWN, Pa., June 24, 1889

ENGINEERING NEWS PUB. CO.

Gentlemen:—Will you kindly send to my address another copy of your Manual of American Water-Works in which you have my advertisment? My entire establishment and my home are swept away and I would be greatly obliged indeed if you would confer the favor. I am, Very truly,

THOS. WATKINS.

[The above letter explains itself. We are very glad indeed to replace the book, and we suggest also that here is an opportunity for giving genuine assistance in a very practical way. Mr. WATKINS has not asked for assistance, nor authorized us to do so, but he has to rebuild his home and shop, and replace his tools and stock of goods. His pipe jointer is well known and is in demand; we suggest to water and gas companies and contractors having pipe to lay that they send in their orders to Mr. WATKINS, and thus, while helping him to regain a business foothold they will provide themselves with a useful and highly recommended tool for use in their business. Prices of pipe jointers range from $2 for 2-in. pipe to $32 for 48-in. A mud-stained circular, from which we quote, is before us, and a similar one can probably be had (without the mud) on application to Mr. WATKINS. We hope no time will be lost in utilizing th opportunity.—ED. ENG. NEWS.]

ENGINEERING NEWS

AND

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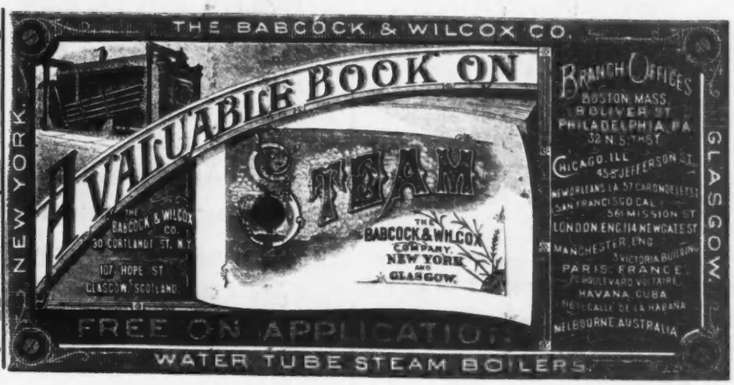
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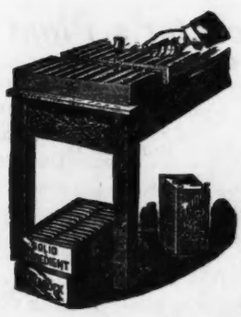

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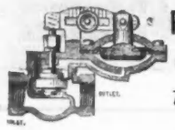
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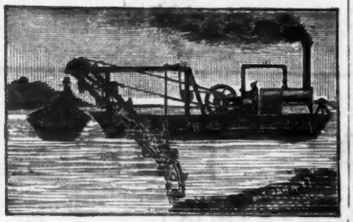
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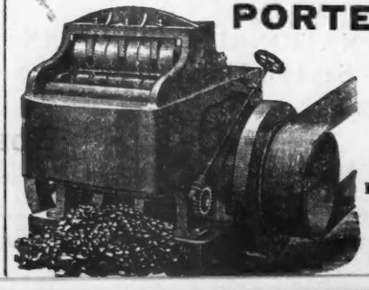
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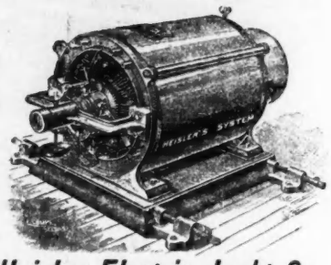

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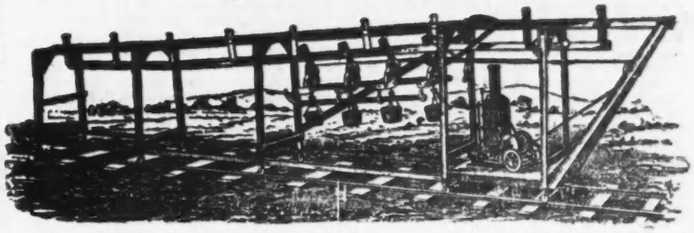

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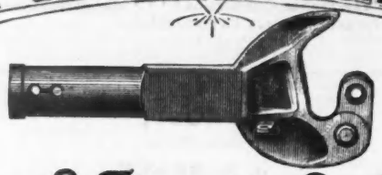

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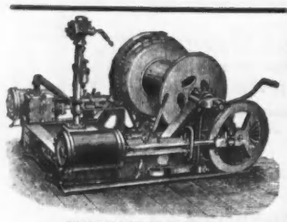

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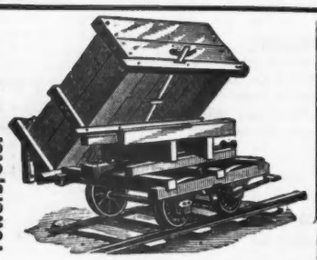

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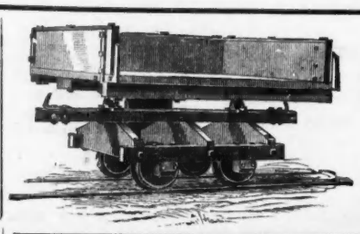

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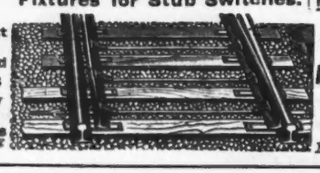

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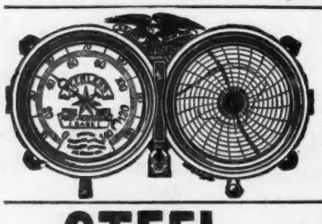

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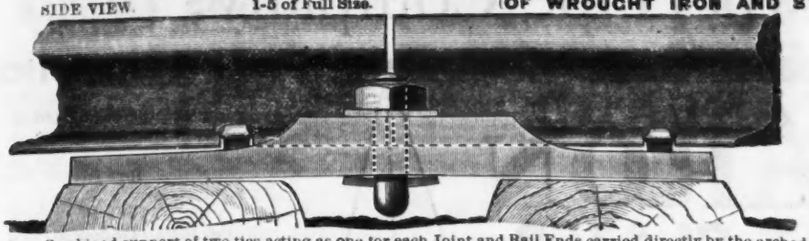

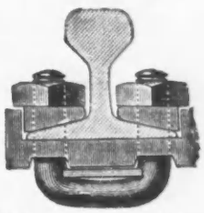

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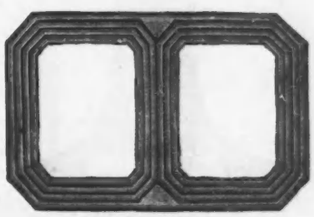

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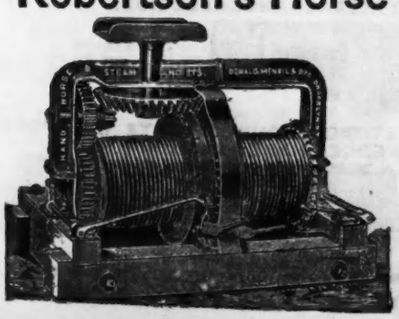

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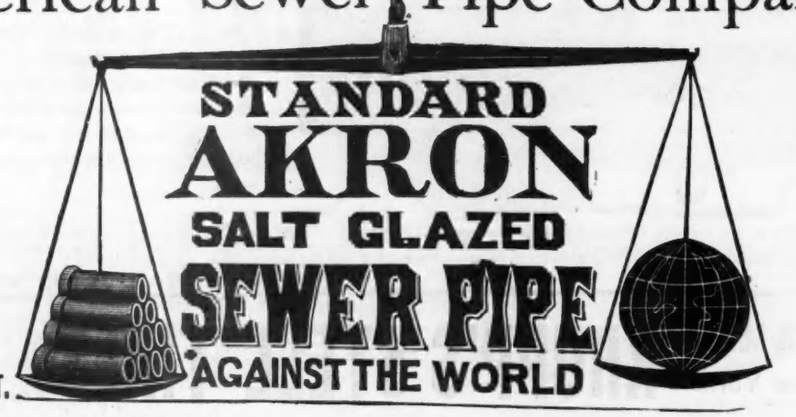

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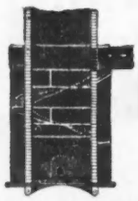

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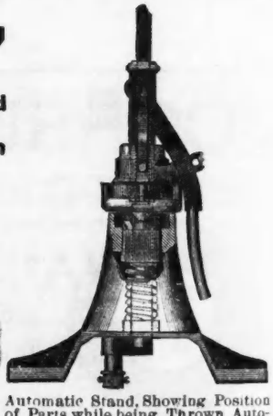

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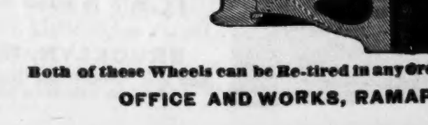

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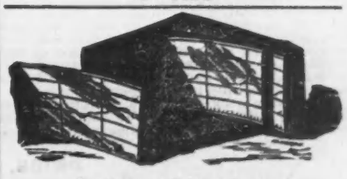
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When it happens that the carcass of an infant alligator plays the mischief with my vitals in its efforts to get through,
I record the strange occurrence on my brass-bound indicator, by the fraudulent addition of a hundred feet or two.

O, the miasmatic matter and the poison which I scatter with the simple name of water, unadulterated pure!
While my friend the undertaker waxes richer, slicker, fatter, and the druggist's wife and daughter take a European tour!

O, I often pause and wonder as I ponder o'er my plunder, pause and wonder why in thunder honest people let me lie,
Why they do not rise in anger, tear me limb from limb asunder, and adopt a water meter more ingenuous than I!

The writer of the above verses has evidently had experience only with the **other** meters, not with ours. We "positively" measure the "infant alligator" and "displace" him dead or alive at your regular rates per cubic foot. No "fraudulent addition" or subtraction is possible.

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This circular seeks to convey the impression to the trade that the decision to which it refers finally determines the fact that the Hersey meter is not an infringement of our patent rights and that, consequently, any person is now and henceforth free to purchase or use such meters without risk of incurring any liability to us as infringers. As this is not *true*, and as this circular contains so much besides which is false in both statement and suggestion, we believe that it is as much our duty to the public as to ourselves to give the following brief statement of facts:

The litigation between our Company and the Hersey Meter Co. to determine whether their meter is an infringement of our patents is by no means ended. We believe that the decision of Judge WALLACE is based on an *erroneous conception of facts*, and therefore an appeal will be taken at once to the Supreme Court of the United States. Of this fact the Hersey Meter Co. have been notified, and every effort is being and will be made to have the case heard and finally determined there at the earliest possible date. If we finally obtain a reversal of Judge WALLACE's construction of our patent, as we confidently expect to do, purchasers or users of the Hersey meter will be liable in damages for their invasion of our rights *in the mean time*. The decision of the Circuit Court is **not final** until it has been affirmed by the Court of last resort.

We deem it in this connection our duty, also, to make the grounds and effect of the decision of the Circuit Court known to the trade and those contemplating the use of the Hersey meter. While Judge WALLACE holds that this meter does not infringe the Crown patent on which the action was brought **he affirms the validity of our patent**. On the other hand, the assertion made in the Hersey circular that this decision "in fact involved the validity of their patents" **is absolutely false**, since those patents were not in litigation and could not possibly have been adjudicated there.

We have heretofore deemed it unnecessary to take any notice of the declarations of the Hersey Co. that our policy was one of intimidation rather than litigation. At the very time that these declarations were most frequent and forcible we were doing our best to secure service of process upon them in the district where this company resides. Within forty-eight hours from the time that we first learned that the Hersey meter was for sale here, our counsel called upon their agents and purchased a meter, at the same time informing them that an action for infringement was to be brought at once, and that the meter was purchased for that purpose. Immediately thereafter, and as soon as it became apparent to them that they could no longer escape our suit, the Hersey Meter Co. sent us a letter through their counsel, generously offering to accept service of subpœna, so that we might be able to commence our action—a letter full of humorous pleading that we sue them at once and containing all sorts of threats should we fail to promptly accommodate them We presume that the letter was made for publication, but we do not believe any one will be deceived by tactics so transparent.

In just where the Hersey meter fails to be an exact copy of the "Crown," there it falls below the standard of excellence which our meter has attained. It has never been our policy in the past, and we do not now intend, to enter into competition to reduce the cost of our meter at the sacrifice of **ACCURACY, EFFICIENCY AND DURABILITY.**

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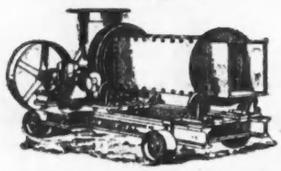

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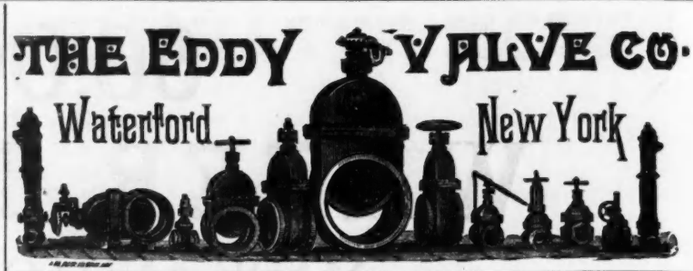

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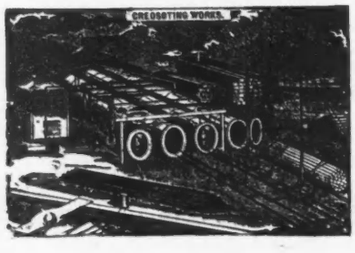

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CREOSOTING WORKS.

1ST. & NEWTON CREEK, LONG ISLAND CITY.

New York Office, 160 Water Street.

Timber Creosoted by our improved process. Creosoted Piles and Railroad Ties furnished

GEO. S. VALENTINE, Manager.

Introduced in 1838, and up to 1886 DEAD OIL OF COAL TAR is the only known product that will preserve timber for all purposes. Approved by the "Committee on the Preservation of Timber" of the American Society of Civil Engineers. We use only the best DEAD OIL OF COAL TAR which has stood the tests since 1838, and is to-day the only known product that has successfully withstood the ravages of marine, and other insects preserved decay and added strength to timber.

REFERENCES:

Reference is made to the following, being a few of those who have used our timber since 1879:

FOR DYKES.—Gen. Newton, U. S. A., Gen. Gillespie, U. S. A., Gen. McFarland, U. S. A.

FOR BREAKWATER.—Gen. Roberts, U. S. A., Gen. Macomb, U. S. A., Gen. Weitzel, U. S. A.

FOR WHARFS.—Gen. Abbott, U.S.A., Hoadley & Co. Costa Rica, National Storage Co., New York, Department of Docks, New York, Tampa Bay R. R., Fla., S. S. Aserson, C.E., Brooklyn Navy Yard, N.E.R.R., Charleston, Grand Trunk R. R., Canada, Lehigh Valley R. R., Philadelphia, Philadelphia & Reading R. R., Phila., Juragua Iron Co., Cuba.

FOR BRIDGES.—N. Y. Brooklyn Bridge, New York, A. P. Boller, C. E., New York.

FOR BLOCKS.—J. T. Pierson, Hayti. FOR SEWERS.—A. B. Hill, C. E., N. H.

FOR UNDERGROUND CONDUITS.—N. Y. & N. J. Tel. Co., Brooklyn.

FOR DRY DOCKS.—J. & J. Torrance, Pictou, N. S.

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Double and Single Gate
—VALVES.—
ALSO
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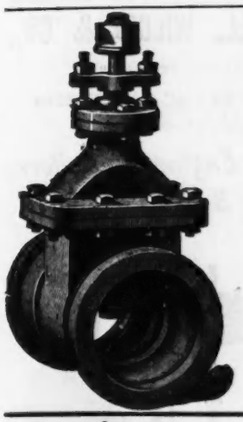
Foot Valves
and Yard and Wash
HYDRANTS.

SEND FOR CIRCULARS.

PEET VALVE CO.



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DOUBLE GATE VALVES
FOR
STEAM, WATER, GAS,
ETC., ETC.. ETC.
¾ to 36 inches.
163 ALBANY STREET,
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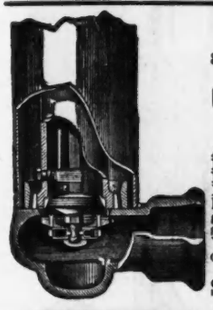
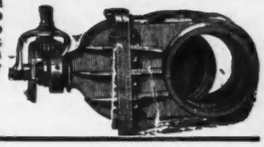


30, 32, 34 and 36 Brush Street, Detroit, Michigan
MANUFACTURERS OF JAMES FLOWER'S
NOISELESS CHECK & PUMP VALVE,
Patent Loose Disc Stop Valve,
For Steam, Water or Gas. Also, JAMES FLOWER'S PATENT ANTI-FREEZING FIRE HYDRANT, with Loose Frost Case and Patent Positive Waste. Also, DUPLEX VALVE FIRE HYDRANT, Patented Aug. 12, 1882. Said Duplex Valve is to allow of fire hydrant being taken out of the ground for repairs without stopping flow of water in mains. We can attach said valve to any common fire hydrant.



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PATENTED IMPROVED
Fire Hydrants
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198, 202 and 204 East Front Street,
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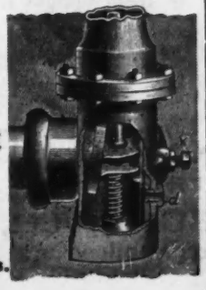
HOLYOKE

Unexcelled for simplicity of construction, durability and low cost of maintenance.
All wearing surfaces of composition, drips below the main and cannot freeze.
Stones or gravel will not clog it.



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STEAM, GAS AND WATER
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FIRE HYDRANTS
WITH OR WITHOUT INDEPENDENT VALVE
All Valves and Hydrants furnished with BABBIT METAL SEATS and
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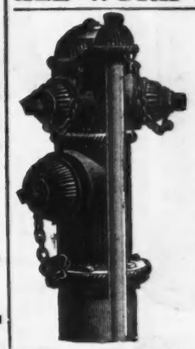
72 KILBY STREET, BOSTON, MASS
CHICAGO OFFICE: 24 WEST LAKE ST
ALL WORK GUARANTEED

THE BEAUMONT FIRE HYDRANT.



Is simple, durable, frost-proof, inexpensive and inefficiency unapproachable.
The valves are of the best gun metal. It has a very superior positive waste valve. All hydrants are tested to 300 lbs. hydraulic pressure.
It will deliver a fire stream of larger volume and greater force than any other hydrant, a most valuable feature in gravity systems.
It has now been in use four years and has been adopted by U. S. Government, State of Illinois and others.
Recommended by National Association of Fire Engineers, 1883.
Extract from appendix to report on hydrant tests, by Selim H. Peabody Ph.D., LL.D., Regent, University of Illinois.

BEAUMONT,	6.2	Friction loss per cent. in lbs. per square inch in hydrants used without nozzle, 50 feet of hose.
LUDLOW [gate]	25.6	
CREGIER [comp.]	37.8	

Send for Full Report.

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GALVIN BRASS & IRON WORKS,

MANUFACTURERS
Conical Compound Wedge Gate Hydrant.
VALVES
FOR WATER, STEAM GAS AND OIL.
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Branch Office, 152 & 154 Lake St., Chicago, Ill.
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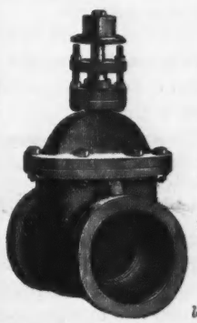

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Fire Hydrants.
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Galvanized Work.

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298 & 300 Monroe St., N. Y.

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MANUFACTURERS AND JOBBERS OF
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Steam, Gas & Plumbing Materials
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15 to 21 *Oliver St., BOSTON.*

Graduating Engines.

Engineers and surveyors when in Philadelphia are requested to call and examine our line of

GRADUATING ENGINES.

The vital point of a transit instrument is the graduation. Defects in other parts may prove an annoyance or inconvenience, and yet instrument work correctly. With defects of graduation, accuracy, if not impossible, is a mere matter of accident. Defects in ordinary parts of instrument become evident to the engineer. In the graduations they are unknown; and frequently the only evidence of their existence is the unsatisfactory condition of the finished work, leaving the engineer in doubt whether the unsatisfactory results, condemning his work, arises from his own carelessness or the imperfections of his instrument. It is not necessary errors should be found in all parts; the mere fact that an error may exist anywhere is sufficient to throw doubt upon the work. In fact, the want of *positive knowledge* that *no error can exist*, is sufficient to make every conscientious engineer hesitate in the choice of an angular instrument.

(CONTINUED NEXT WEEK.)

Young & Sons,

Engineering, Mining and Surveying Instruments.

43 N. Seventh St., Philadelphia.

Flange Cover. Covers for Service Boxes

BINGHAM & TAYLOR'S

NEW PATTERN

Extension Service Boxes.

This box is constructed in two sections, which screw together, the lower one inside the upper section, thus forming one continuous pipe or box, easily adjusted exactly to the height and depth required, and will remain where set in position upright and firm as though all made in one piece.

With Non-detachable Covers,—a new feature—avoiding the annoyance and expense heretofore experienced by covers being lost or stolen.

The bolt being of brass will not corrode and is therefore free at all times to be opened with the proper key.

Shut-off Boxes for Street Valves.

These are adjustable to length on same principle as the service box described above. They are made sufficiently strong to withstand the wear of the heaviest teams passing over them, and therefore are of great advantage in paved and improved streets.

They are constructed in three sections; the base or lower section, which covers and protects the dome of the valve, has a broad flange extending around the bottom of the same, thereby giving it a good foundation to rest upon and prevent settling.

The value of these cast-iron boxes will at once suggest itself to all waterworks and gas companies which have been subjected to the constant expense and annoyance of replacing boxes after a short use, and which have become worthless or rotted out, and therefore dangerous to travel over them.

For any change of street grade or repaving, our Iron Box can be used again and re-adjusted up or down to conform with change of grade.

We have on hand, and will supply any lengths required, the different sizes extending from two to eight feet in length, and suitable for valves up to thirty-six inches; the inside diameter of these upright shafts or pipes is five inches or seven inches as required.

All our Boxes are coated with **coal tar** inside and outside to protect from rust, etc. This box has been thoroughly tested and adopted by over **500** Water & Gas Companies and is acknowledged to be the **Best in use.**

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MANUFACTURERS,

BUFFALO, N. Y.

Nickel Plate Models Sent Free on Application.

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MANUFACTURE AND SELL EVERY ARTICLE, TOOL OR APPLIANCE NEEDED AT

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Either for Gas, Oil, Water, or Mineral Tests.

BOILERS, CASING,
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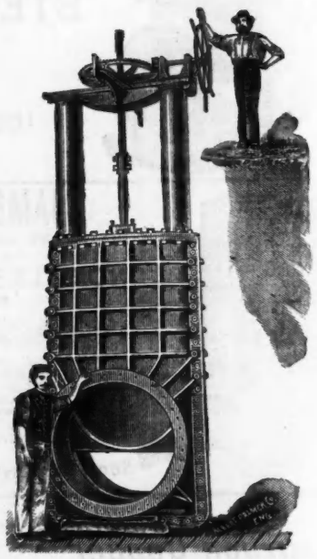
from 12 to 48 inches.

Steam Engines, Boilers, Iron & Brass Castings,



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Drinking Fountains,

AQUARIUMS, &c.

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Office, Equitable Building,

FACTORIES: Ewing Ave. and Pacific R. R.; Arsenal St., and St. L. O. H. & C. R. R.

AN OPEN LETTER

To Purchasers of Sewer Pipe. *St. Louis, June 15, 1889,*

Since the completion of our new works, we are the largest manufacturers of Vitrified **Sewer Pipe** west of Ohio. We find also that our product is in excess of the requirements of our present trade, and, desiring to extend our operations, we write to ask if we may not do some bnsiness with **you.** We have no connection with any combination or trust to control and maintain exorbitant prices for **Sewer Pipe,** being satisfied with a fair profit on our sales, and our long and pleasant acquaintance with freight officials of Railroads entering St. Louis, insuring to us always the lowest rates of freight, we believe that we can make it an important object for you to place your orders for **Sewer Pipe** with us.

As regards the quality of our **Sewer Pipe,** while it is—in appearance and in fact—admittedly the best pipe made in the West, it is not uniformly quite as well glazed, inside and out, as the Ohio pipe, nor perhaps quite as smooth, but the material is of excellent quality ; and the finished pipe, for all practical uses, is equally as good, and will last as long as any pipe made in this country—this we warrant, and will prove by any inside or outside pressure test that may be required.

We invite your attention especially to our **Double Strength Culvert Pipe,** which we make in lengths of 2½ feet, with improved sockets. This pipe is unquestionably the best material known for small **Railroad Culverts** ; also **Water Works Conduits,** where water is required to be carried to a Reservoir or distributing point by **gravity.** (Our pamphlet, "Something about Culvert Pipe," describing this pipe and illustrating its advantages, will be sent you on application.)

We enclose folder showing both Eastern and Western Price List of **Sewer Pipe** The Eastern List, you will notice, is much the higher. We make our prices by discount from either list, and in all cases sell all our product **delivered at destination,** we assuming all risk of damage in transit, receiving freight bill in part payment, and giving purchaser credit for all breakage.

Our usual terms to responsible purchasers are 90 days by acceptance, or 3 per cent. discount (after freight is deducted) for cash on rece ipt o goods. We shall be much pleased to hear from you. Very Respectfully,

BLACKMER & POST,

R. D. WOOD & CO.,

Engineers, Iron Founders, and Machinists.

400 Chestnut St., PHILADELPHIA, PA.

CONSTRUCTORS OF GAS AND WATER-WORKS, AND MANUFACTURERS OF CAST-IRON PIPE

OF ALL KINDS AND SIZES.

Foundries and Works: MILLVILLE, FLORENCE AND CAMDEN, New Jersey.

MATHEWS' SINGLE AND DOUBLE VALVE FIRE HYDRANTS. *Eddy Valves, Lamp Posts, &c.*

GAS HOLDERS AND GAS MACHINERY. HYDRAULIC CRANES, PRESSES, LIFTS, &c. TURBINES AND WATER POWER PUMPS.

CHEMICAL AND SUGAR HOUSE WORK, LOAM CASTINGS, HEAVY SPECIAL MACHINERY, GENERAL CASTINGS.

CAST-IRON PIPE FOR CULVERTS, DRAINS &c. (12 ft. lengths.)

These railroad men are feeling very sore,
And the road has lost some twenty thousand more;
For a door crack yawning wide
Has allowed a spark inside,
And henceforth they'll always use the DUNHAM DOOR.

SPECIALTIES OF THE DUNHAM MANUF'G CO.

Storm Proof Freight Car Door, Hot Pressed Steel Stake POCKET,
Baggage Car Door, Stock Car Door, Common Sense Grain Door,
Globe Ventilators, Servis Railway Tie Plate, Reed's Car Replacers.

Send for Pamphlet giving full information.

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TRAUTWINE'S POCKET BOOK.

"Without doubt it has proved itself to be the most useful hand book in the language for the engineering profession."—*Engineering and Mining Journal*, Aug. 25, 1888.

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For WATER, GAS, railroad and turnpike CULVERTS and SEWERS. BRANCH CASTINGS of all descriptions; HYDRAULIC CYLINDERS General MACHINE CASTINGS and FLANGE PIPE.

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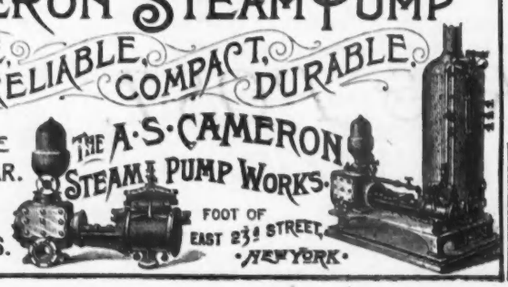
SIMPLE, RELIABLE, COMPACT, DURABLE.

NO OUTSIDE VALVE GEAR. ADAPTED FOR ALL PURPOSES.



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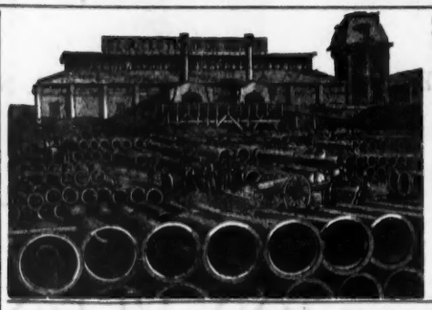

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CAST-IRON GAS AND WATER PIPE,

11-2 inch to 48 inches diameter inclusive.

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THE WYCKOFF CREOSOTING CO.

Creosote all kinds of Lumber, Railroad Ties, Telegraph Poles, etc

ALSO MANUFACTURERS OF

PATENT WOODEN WATER PIPE.

Cheapest and best in the World.

Send for Circular. WILLIAMSPORT, PA

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New York Office, 160 BROADWAY

CAST IRON WATER AND GAS PIPE.

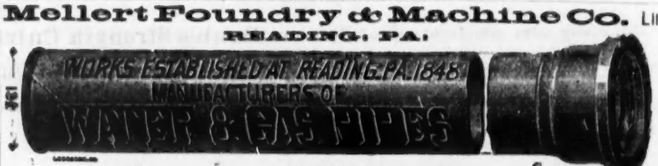
FROM TWO TO FORTY-EIGHT INCHES DIAMETER.

Branches, Bends, Retorts, Etc.

BEAMS AND COLUMNS. A theoretical and Practical Treatise on the Strength of Beams and Columns; in which the ultimate and the elastic limit strength of beams and columns is computed from the ultimate and elastic limit compressive and tensile strength of the material, by means of formulas deduced from the correct and new theory of the transverse strength of materials. By ROBERT H. COUSINS, 170 pages. Octavo, Cloth, $5. E. & F. N. SPON, Publishers, 12 Cortlandt St., N. Y.

Mellert Foundry & Machine Co. Limited

READING, PA.



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HYDRAULIC TUBE WELL CONSTRUCTION CO.,

145 Broadway, New York, N. Y.

Water Supplied for Cities, Villages and Manufacturing Purposes, by a New and Improved Process.

CORRESPONDENCE SOLICITED.

Globe Special Castings

FOR WATER-WORKS.

Adopted in 1887 by more than 100 Towns and Cities.

BUILDERS IRON FOUNDRY, Providence, R. I.

150 CAR-LOADS OF

Sewer Pipe, Culvert Pipe, Water Pipe and Terra Cotta Goods

OF EVERY DESCRIPTION.

FIRE BRICK, FIRE CLAY, &c. produced daily

THE GLOBE SEWER PIPE CO.

PITTSBURGH PA

GENERAL OFFICES: 421 WOOD STREET.

Twenty-four factories located at various advantageous shipping points throughout the States, enable us to reach all markets with the largest supply of goods at the lowest freight rates and the least delay of any similar company in existence.

Notice To Contractors.

CITY of POUGHKEEPSIE, N. Y.,
Department of Water-Works and Sewers,
Commissioners' Office, June 19, 1889.

Sealed proposals will be received at this office until noon of Tuesday, July 2d, 1889, for

Laying about 1,500 ft. of 22-inch and 24-inch vitrified sewer pipe—excavation from 12½ ft. to 25 ft. in depth, lower half in rock—and constructing 14 manholes and 6 silt basins; pipe delivered free of charge to contractor; all other materials to be furnished by him.

Plan and profile may be seen, and copies of specifications, contract and form of proposal obtained at this office.

The party to whom the contract is awarded will be required to execute a bond, with approved surety, in the penal sum of $6,000, and each proposal must contain the name and address of the person offered as surety.

The right is expressly reserved to reject any or all proposals if the interests of the city shall seem to require it.

Proposals must be made upon forms to be obtained on application at this office, enclosed in a sealed envelope addressed to the undersigned, and endorsed "Proposal for Laying Sewer Pipe."

By order of Commissioner.

CHAS. E. FOWLER,
Superintendent Water-Works and Sewers.
25-2t

Sewerage System.

Sealed proposals for constructing a system of sewerage for the city of Raleigh, N. C., will be received until July 15. Address, J. L. LATTA, Chairman Sewerage Committee, or J. L. LUDLOW, Engineer.

RALEIGH, N. C., June 21, 1889.

City of Plainfield, N. J. Water-Works.

Sealed proposals for the construction of water-works in the city of Plainfield, New Jersey, will be received up to AUGUST 5th, 1889, to be publicly opened at the hour of 8 o'clock, P. M. in the Common Council Chamber.

Bids are solicited for water-works, either on franchise plan with privilege of purchase by City shortly after completion or after ten years, or on plan of contracting with City solely for constructing the works.

Water supply by wells or from Passaic river, or other neighboring source. About 20 miles of water pipe required within city limits. Bidders to furnish all plans and specifications of such works as they propose to build. General specification of requirements may be obtained by addressing the City Clerk. Actual time allowed for completion of works, twelve months from date of contract. All proposals should be delivered to the City Clerk and marked. "Proposals for the Construction of Water-Works in the City of Plainfield, New Jersey."

The Council reserves the right to reject any or all bids. O. B. LEONARD,
City Clerk.

Plainfield, N. J., June 21st, 1889. 26-4t

Two Harbors, MINN., Water-Works.

Sealed proposals will be received by the President and Council of Two Harbor, Minn. up to 7.30 P. M. of July 10th, 1889, for supplying the labor and materials for the construction of Water-Works, for the town of Two Harbors, Minn., in accordance with the plans and specifications.

The work to be let consists of one high pressure pump with boiler, stack, etc.; frame pump house; wood water tower; cast-iron pipe and pipe laying; and valves and hydrants. Bids will be received for the entire work or any part thereof.

Each bid shall be accompanied by a certified check payable to the town, for an amount equal to 3% of the amount of bid; as a guarantee that the contract will be entered into and the necessary bond furnished, within 10 days after the awarding of contract to the bidder by the town. Plans may be seen and specifications procured at the office of the City Attorney and of the Engineer. The right is reserved to accept that bid which is to the best interest of the city, whether the lowest or not, and to reject all bids if desired. W. W. CURTIS, Engineer.

Drake Block, St. Paul, Minn., June 22d, 1889.
26-2t

BENHAM HYDRAULIC MOTOR CO.,

Cor. Gaspee and Francis Streets,

PROVIDENCE, R. I.

MANUFACTURERS OF

WATER ENGINES.

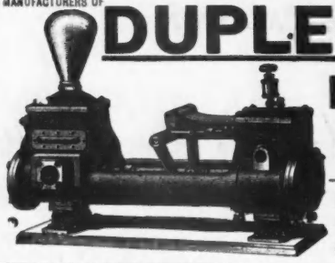
HEAVY HYDRAULIC ENGINES

WITH REVERSING GEAR KEPT IN STOCK OR BUILT TO ORDER.

ESTIMATES FURNISHED ON APPLICATION.

THE GORDON STEAM PUMP CO.

MANUFACTURERS OF



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PUMPING MACHINERY FOR ALL DUTIES

Send for Illustrated Catalogue.

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NEW YORK, 96 LIBERTY ST.
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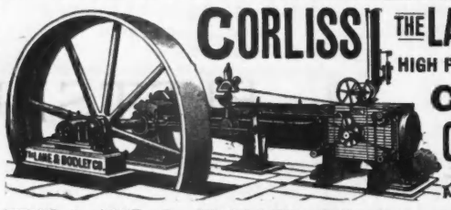
THE CROSBY WIRE ROPE CLIP.

The Cheapest and most effective
WIRE ROPE FASTENING
IN THE WORLD.

Send for Price-List.

AMERICAN MAN'F'G CO.,
ST. PAUL, MINN.

CORLISS



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HIGH PRESSURE, CONDENSING and
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CORLISS ENGINES
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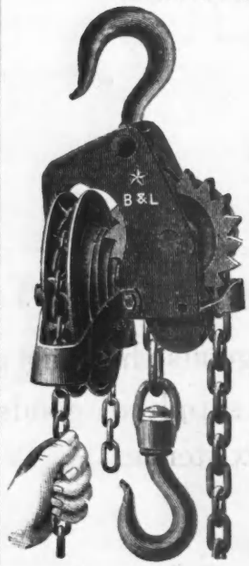

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ADVERTISER would like to meet or correspond with parties interested in the manufacture of Portland cement. New process insuring quality and cheapness. May be patented. Address SILICA, this office. 23-6t

A FIRST CLASS Draughtsman wanted, one thoroughly acquainted with structural iron work for buildings, bridges, etc.; none but those thoroughly acquainted need apply. Permanent position with good pay. Apply care of Engineering News. "Iron Works." 23-4t

AN ENGINEER thoroughly acquainted with railroad location and who is a good instrument man desires position. Has had charge of party and also had some experience on construction. No offer of less than $100 per month considered. Address A. B., care Engineering News. 24-3t

A YOUNG ENGINEER of 4 years' experience desires an engagement as in charge of party, transitman or leveler. Best of references. Address C. T. WEAVER, 15 Robbins St., Waltham, Mass. 24-3t

A CIVIL ENGINEER (M. Am. Soc. C. E.) of 20 years' experience, largely in the location and construction of Western railroads, would like an engagement. Difficult location a specialty. Address B. W., care Engineering News. 24-3t

WANTED—Engineering News of March 17, 1888 Will pay 25 cents for a copy in good condition Address FRANK C. HORN, care Engineering News 24-3

POSITION AS ASSISTANT to surveyor or engineer by young man (American) of good education and three years' practice in field and office work of a city engineer. Good references. At liberty July 6th. Address "R. S." Box 606, Brantford, Ont., Canada. 25-3t

POSITION WANTED by a young engineer; years' experience on water-works, railway locating corps and sewers. Address A. J. COLE, 8 Spring St., Albany, N. Y. 25-3t

SITUATION WANTED as Engineer; has had 26 years' experience on land and water, capable of taking charge of a High, Low or Compound engine, doing all my own repairs, having served seventeen years at the West Chester Water-Works as Superintendent. I can give the best of reference. CHARLES F. HENRY, West Chester P. O., Chester Co., Penna. P. O. Box 1 13. 20-9t

WANTED.—An Assistant Engineer to take charge of a party on city work, Salary $75. Also a draughtsman, $15 per week. Permanent employment in a city within 5 miles of New York Address CITY ENGINEER, care Engineering News.

A PRACTICAL working corps, two or more, with full set of instruments, desires engagement. First man graduate U. of P. Assistants practical and hard workers. Will contract or engage for the season. Address, CORPS, care Engineering News. 26-1t

A YOUNG civil engineer desires engagement in any work pertaining to his profession. Practice principal object. Address C. E., Engineering News. 26-1t

WANTED—Charge of drafting room in R. R. office; thoroughly experienced in designing of bridges and trestles, masonry and railroad buildings of all kinds, etc. Best of technical education and 9 years' professional practice. Address H. S. care Engineering News. 26-1t

WANTED a first class bridge engineer and contracting agent, of at least three years actual experience both as to independent designer and business representative. Permanent engagement guaranteed to party possessing the above qualifications. Address San Francisco Contracting Co., No. 6 California Street, San Francisco, Cal., stating previous experience, references as to character and ability, salary expected and other particulars. Photographic likeness desired. 26-4t

WANTED.—Position by an engineer of 11 years experience. Specialties, hydraulics and sewerage. References first class. Address CIVIL ENGINEER, Boston, Mass., Box 3612. 26-3t

AN ASSISTANT ENGINEER, with practical knowledge of sewer work, for large city in California. Salary from $100 to $125 per month, according to ability. Address at once, giving experience and reference, X. Y. Z., Engineering News. 26-1t

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A GOOD OPPORTUNITY.—A young man with a good technical education and some practical experience can obtain an interest in a general engineering business in one of the best sections of Colorado. Will probably yield $1,500 to $2,000 the first year. Very little capital required. RANKINE care of Engineering News 26-3t

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The highest duty; Moderate cost; Low piston speed; Simplicity in design; Ease of management; Best steam distribution; Best pump action; Uniform stroke. Adaptability to every conceivable service, Highest accredited performance by well nown experts.

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The Total Daily Capacity of this type of engine sold over 450,000,000 Gallons.

Expert Trials have been made as follows:

YEAR.	PLACE.	Gallons per 24 hours.	Duty in foot pounds.	EXPERTS.
1882	Saratoga, N. Y.	5,000,000	112,899,983	Prof. D. M. Greene, C. E., Troy, N. Y. / J. W. Hill, M. E., Cincinnati, O.
1883	Saratoga, N. Y.	5,000,000	106,838,000	Chas. T. Porter, C. E., New York City.
1884	Omaha, Neb.	5,000,000	102,000,000	J. D. Cook, C. E., Toledo, O.
1884	Columbus, O.	10,000,000	115,400,000	T. R. Mendenhall, C. E., Washington, D. C.
1886	Buffalo, N. Y.	15,000,000	125,907,297	Jno. W. Hill, M. E., Cincinnati, O.
1886	Leavenworth, Kan.	5,000,000	110,478,000	Thos I Whitman C E St. Louis Mo
1886	Hyde Park, Ill.	12,000,000	110,600,000	Chas. Hermany, C. E., Louisville, Ky.
1886	Kalamazoo, Mich.	3,000,000	102,728.884	Jno. W. Hill, M. E., Cincinnati, O.
1887	Lima, O.	3,000,000	110,482,946	J. D. Cook, C. E., Toledo, O.
1887	Erie, Pa.	5,000,000	122,442,491	F. A. Scheffler, C. E., Erie, Pa.
1887	Chicago, Ill.	2 engines of 12,000,000 each.	102,000,000	Prof. R. H. Thurston, Cornell University, Ithaca. N. Y / J. S. Coon, C. E., Burdett, N. Y. / Jas. N. Warrington, M. E., Chicago, Ill.
1887	Phila., Pa.	20,000,000	125.022,730	John E. Codman, C. E., Phila., Pa.

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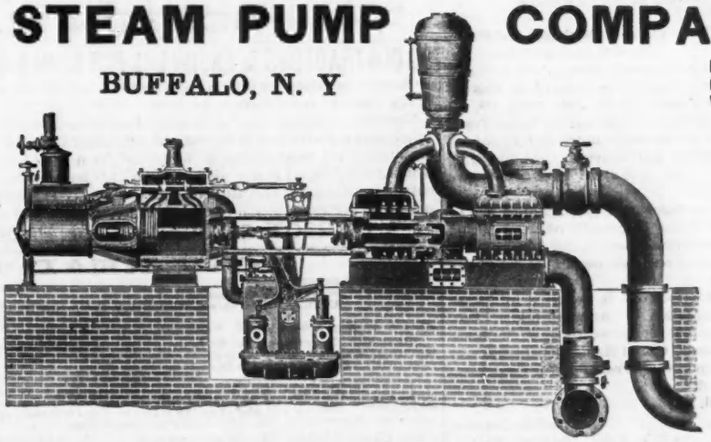

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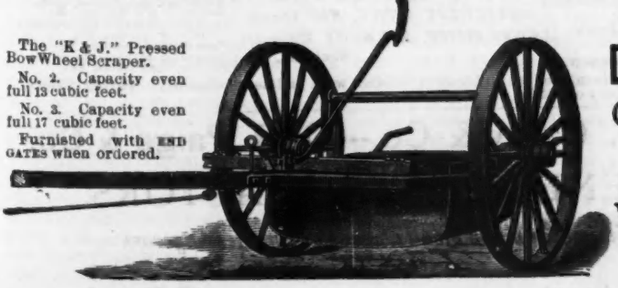

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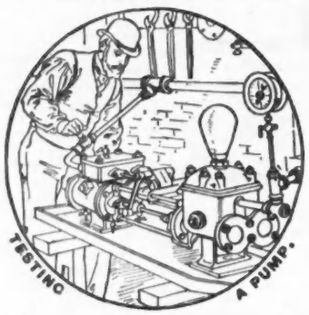
Special Instruments of Precision for sale, made and designed for the use of **Civil, Military, Surveying, Mining, Hydraulic, Electrical, Astronomical** and **Meteorological Engineers,** and for kindred Scientific purposes.

For further particulars, call on or address,

WM. CLIRDAM & SON, 96 John St., New York.

Who will be pleased to refer you to their large circle of patrons, all through the United States and Canada.



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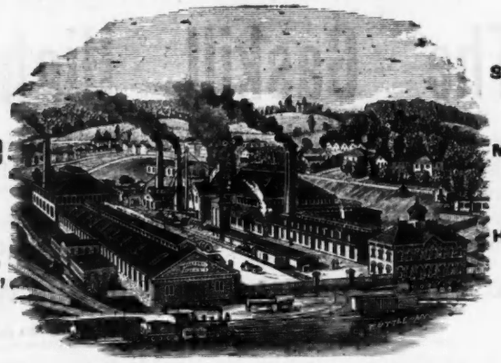

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Machinery for Flour Mills, Grain Elevators, White Lead Works, Fertilizer Factories and Dredging Machines.

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THE ONLY METAL WHICH IS

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First-class Brass, Bronze and Gun-Metal Castings of all descriptions.—Estimates given for all kinds of Brass Work.

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TO CONTRACTORS & ENGINEERS FOR SEWER & LARGE WATER TRENCHES

Carson's machine for digging and back-filling, introduced ten years ago, was the result of much expenditure of time and money.

Numerous persons have since tried to appropriate it by the easy process of copying its important features and changing and patenting some minor details. None have succeeded although some have obtained "opinions" *from their own attorneys* that their construction would not infringe! If any wish a JUDICIAL decision let them point out some of their machines in successful operation on actual work. The under signed furnishes at low prices, machines perfected by ten years use in many places. See adv't. outside page.

H. A. CARSON, 21 Hamilton cor. Franklin St., Boston, Mass.

NOW READ THIS!

M. D. LEGGETT, Counselors in patent causes and Solicitors of patents. L. L. LEGGETT.
OFFICES: 913 F Street, Washington, D. C. City Hall Building, Cleveland, Ohio. LEGGETT & LEGGETT.
Washington, D. C., June 16th 1888.

JOHN RYAN, Esq., 5 Hawk Steet, Watertown, N. Y.

DEAR SIR:—Your favor of the 5th came to hand and contents carefully noted. In reply thereto would say that we have made a careful study of the claims in the Carson patent No. 228,960, and are of the opinion that your construction will **in no wise** infringe these claims.

Respectfully, LEGGETT & LEGGETT.

NOTE:—M. D. Leggett was for many years "Commissioner of patents" and is one of the **ablest** patent lawyers in the U.S. We are prepared to **defend** the above opinion and our rights to the full extent of the law if necessary. And we will **indemnify** all users of our machines against loss or damage on account of any claims for infringement. See advertisement on page three.

John Ryan, 5 Hawk St., Watertown, N.Y. M.J.Sheahan, 41 McCaul St., Toronto, Ont.

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Incorporated under the Laws of the State of New York as a full Liability Company.

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Estimates furnished for all kinds of building work and heavy masonry. Paving Blocks furnished in any quantity.

Paige, Carey & Co.--- D. R. Paige & Co.

GENERAL CONTRACTORS.

Estimates made on all classes of Engineering work.

GENERAL OFFICES.

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NEW YORK.

Raleigh, N. C., Sewerage.

Sealed proposals will be received by the Sewerage Committee of the Board of Aldermen of the City of Raleigh, N. C., at the Mayor's Office of said city, until 3 o'clock P. M of Monday, July 15th, 1889, for constructing the proposed system of pipe sewers for said city —approximate extent twenty one (21) miles.

Copies of the general plans and specifications, forms of proposals and instructions to contractors and any information relative thereto, may be obtained from the Chairman or Engineer of the Sewerage Committee. The Committee reserves the right to reject any or all bids. C. G. LATTA,

Chairman of Sewerage Committee.

J. L. LUDLOW, C. E., Engineer. 26-3t

Second Hand Iron Rails.

For sale in one or more lots 1,000 tons 40 lb. second hand iron rails with splice bars well fitted for re-laying. Are lying at a point suitable for Western delivery. Address P. O. Box 940.

PITTSBURGH, PA.

Proposals for the Construction and Erection of a Police Patrol, Telegraph and Telephone System.

Office of the Commissioners, D. C.,
June 27, 1889.

Sealed proposals will be received at this office until 12 o'clock, M., on Monday, July 15th, 1889, for the construction and erection of a Police Patrol Telegraph and Telephone System in the city of Georgetown, District of Columbia.

Blank forms of proposals and specifications can be obtained at the office of the Superintendent of the Telegraph and Telephone Service, corner of 5th and D Streets, N. W., Washington, D. C., upon application therefor, together with all necessary information, and bids upon these forms only will be considered.

The right is reserved to reject any or all bids or parts of bids.

J. W. DOUGLASS,
L. G. HINE,
CHAS. W. RAYMOND,
Commissioners, D. C.

26-3t

Tuxedo Park Dam No. 5.

Sealed proposals for Construction received at office of Samuel McElroy, C. E., Room 39, 190 Broadway, N. Y. City, until July 10th, at noon. Plans and papers ready July 1, and at Engineer's Office, Tuxedo. 26-1t

U. S. ENGINEER OFFICE, WILMINGTON, N. C., June 24, 1889.—Sealed proposals for $80,000 of stone, mattresses, etc., in place in dike in Winyaw Bay, S. C., are to be received at this office until 10 A. M., on July 24, 1889. The attention of bidders is specially invited to Acts of Congress approved Feb. 25, 1886, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. All information furnished by W. H. BIXBY, Captain of Engineers. 26-4t

Notice to Contractors.

Chicago & West Michigan Railway,
Chief Engineer's Office,
GRAND RAPIDS, Mich., June 21st, 1889.

Sealed proposals will be received at this office until 5 o'clock, P. M., July 15th, 1889, for Clearing, Grubbing, Grading, Bridging, Track Laying and Ballasting 75 miles of railroad between Baldwin and Traverse City, Michigan. Contracts will be let in divisions of twenty-five miles or more.

Profiles, contract and specifications can be seen at the Chief Engineer's office at Grand Rapids on and after June 24, 1889.

The company reserves the right to reject any or all bids.

Sufficient bonds will be required to insure proper completion of any work taken. Proposals may be forwarded to J. J. McVean, Chief Engineer, Grand Rapids, Michigan, and should be endorsed "Proposals for Constructing Railroad."

Approved, J. J. McVEAN,
Chief Engineer.

J. B. MILLIKEN, V. Prest. and Genl. Mgr.

26-3t

Notice of Receiver's Sale of Gas Plant.

The undersigned will until the 11th day of July 1889, at the City of Indianapolis, Indiana, offer for sale at private sale all the assets of The Broad Ripple Natural Gas Company, and if not thus sold by said date, he will on the 18th, day of July 1889, sell the same at public auction at the South Door of the Court House of Marion County, Indiana.

Any person desiring to bid will please communicate with the undersigned who will furnish him full copy of the order of sale, giving terms and conditions of sale.

GEORGE B. YANDES,
Receiver, Broad Ripple Natural Gas Company, Indianapolis, Indiana. 26-2t

Specifications for Dams and Reservoirs. Prepared by E. Sherman Gould, Hydraulic Engineer, Scranton, Pa. Published and for sale by ENGINEERING NEWS PUBLISHING Co., Tribune Building, N. Y. City. Price, 25 cents each.

PUBLISHER'S DESK.

Saturday, June 29, 1889.

The Incomes of American Civil Engineers and how they may be increased.

More than a quarter of a century ago the writer was an "apprentice" to a Canadian P. L. S. (Provincial Land Surveyor). We paid a "premium" for the privilege, paid our own living expenses, and received no pay for our services, although our "master" did whenever we were on a survey. The work was laborious and fatiguing and the "living around" was infernally tough. A Canadian Land Surveyor (and for that matter, an American one also) in the "rural districts" needs the stomach of an ostrich, the hide of a rhinoceros, and the endurance of an athelete. Having served our "apprenticeship," secured our papers entitling us to all the privileges and emoluments of a P. L. S, we hung out a shingle and solicited business. It came. A Canadian Land Surveyor receives about $10 per day for his own services; if he has an "apprentice" (or several) he pockets the "premiums," and the charge for one or more as chainmen when on work of possibly $4.00 per day: but the busiest of Canadian Surveyors cannot make over $3,000 per year, and 90 per cent. of them do not make $1,000. We didn't see any great "emoluments" ahead and soon emigrated to more promising fields. We commenced railroading in Wisconsin at $1.25 per day and expenses: transitmen on the same survey were paid $100 per month and "found:" levellers $75 and "found:" that was in 1863 and the pay isn't any better yet,except that the currency is equal to gold and one dollar will now buy more than two would then. The pay of Chief Engineers of railways is about the same now as then and ranges from $2,500 to $6,000 per year. We were 4 years in the offices of the C. & N. W. R. R., and didn't see any very big "money" at the end of that time or the prospects of such, and so by the advice of friendly officials—who are still there—we cut loose from the assured and fairly good salary, with its pleasant office, easy hours, and comfortable life, for the uncertainties of private professional practice and the competition of old established firms to meet. In those days there were no "Civil Engineers" in Chicago. Only City Surveyors. A study of the chart recently published in this journal will show that very little water-works construction was in progress; bridge building was confined to country carpenters or a few bridge building firms: sewer construction was hardly started: the plotting and surveying of new towns and additions to old ones and giving corner and grades of city lots was the sole business of civil engineers and surveyors and from December 1st to April 7, there was not much of even this. Chicago was a "booming" City but a Surveyor had to work early and late to net $4,000 in the best of times, and while the leading Surveyor (who is still at the head) made as much as $12,000 in one year (following the great fire) yet $2,500 was a good income for a Chicago surveyor. There was not a single civil engineer in those days (1871 to 1874) that we can remember making a good income in Chicago by the exclusive practice of his profession.

There are now civil engineers in Chicago who are receiving fees for services and advice, from $2,500 to $30,000 per year: our advertising pages give the cards of civil engineers in many parts of the country who are earning larger incomes than the best salaries paid by any city or railway corporation in the country to their Chief Engineer. We have often wondered at the temerity of the men who have come to us to ask our opinion about abandoning salaries for the chances of private practice: but we have always encouraged them to "go ahead" and win. The experience of their predecessors was encouraging and it made the chances better for the more timid, or more contented ones who were left. If there is a reasonably fair prospect, we advise striking out for ones self as early in life as possible: the longer one accepts the ease of a fixed salary the less he will know of the world outside his own duties: and the less able will he be to meet the difficulties if reverses should come.

This journal has always advocated higher pay for engineering services. English engineers are not superior to American yet the incomes of such engineers as John Fowler, Benjamin Baker, Sir Joseph Bazalgette, Sir Robert Rawlinson, Baldwin Latham, and many others are much greater than the best ever known in this country. The engineering work of Great Britain is in the control of a few leading men who supply numerous assistants and besides have a never ending succession of students who each pay a premium for the privilege of getting into an office and picking up what knowledge of the profession they can. In this country we cannot follow this method. The average American engineer considers himself as good a man as his fellow and he will take the chances of "paddling his own canoe."

One method of advancing one's interests is to keep his name associated with as much engineering work as possible. Sometimes in the advertisement of proposals for contract work, the engineer's name is omitted: this is not right: he should in every legitimate way keep his name before the public and the oftener it is associated with work done or projected under his plans and supervision, the better for him. The names the great English engineers are constantly being mentioned in the engineering and other journals of their country and no class of men are more anxious than they for such advertising.

American engineers then, should use the facilities at hand for their own advancement. As they became known, so will they be sought after, and with the demand for their services will come the opportunity for advancing the price of their services; and the prosperity of one is the gain of all in the familiarizing the public with higher rates of compensation and in the stimulating effects which success produces.

"There is nothing succeeds like success."

Contractors Addresses.—In some directories in our office there are lists of contractors. Some of the men whose names are given have long since passed over to the silent majority, the publishers of the lists having merely copied from an ancient directory so as to get a "list" to use for advertising purposes. Other names are of contractors who have been reported from local directories, or by postmasters. In those cases, every man who takes a job of excavating a cellar, or building a wooden sidewalk, or moving an old frame house, or digging a well, is a "contractor." We have lists of hundreds of these. They do not count in the list we are making. We want to know the home or permanent address of the man or firm who will take a contract to build a railroad of any length in any part of the world and has the plant to do it with; we want to know the same of the man or firm who will build a great bridge or any considerable part of it, or a great sewer, or a water-works, or who will contract for the materials for any of the above.

We are searching our own correspondence and files for two or more years past for the names and addresses of **prominent** contractors; we are sending out hundreds of inquiries by mail: the **permanent** addresses are what we want, and the specialties, so that when the list is an accomplished fact it will be worth something. Jones and Smith working on a railroad contract at Brownsville, Kan., is of no value: in three months they have moved to Palatka, Fla., or to some other place in Texas or Colorado; they might as well be dead men for trading purposes. We want to know where they are to be found when "at home," otherwise we do not want to know them at all. We are solicited constantly for the addresses of contractors mentioned in these columns, and although we have every directory in which such names are given, and are personally acquainted with many addresses, yet we almost invariably fail where we have not already specified the address. It is very annoying to us as well as to the people who want the names for business purposes.

A copy of this list of railroad contractors will be placed, at our expense, in the office of every railroad manager in America, **without fail**. All we ask from the contractors is their names, addresses, and specialties. Other lists will be placed where they will be of service.

There is no doubt these will be standard lists from which every other publisher, or party having use for them, will copy; for why go to the expense of an original list if somebody else has already done all the work and paid the bills? But as we already supply gratuitously a large proportion of the "news" published by so-called contracting journals a week later than we give it from our exclusive correspondence, we are under no apprehension of damage to our interests from that source. The great majority of American business men are ready to give honor where honor is due as we can amply testify from the generous appreciation of our labors in the past.

A Civil Engineer's Library.

Baldwin's Steam Heating	$2.50
Baker's Engineering Instruments	.50
Billing's Water Works Construction	2.00
Bouscaren's Specifications for Iron and Steel Highway Bridges	.25
Bouscaren's Specifications for Iron and Steel Railroad Bridges	.25
Buchanan's Tables of Squares	2.00
Burr's Bridge and Roof Trusses	3.50
Burr's Elasticity and Resistance of Materials	5.00
Butt's Civil Engineer's Field Book	3.00
Cooper's Specifications for Iron and Steel Highway Bridges	.25
Cooper's Specifications for Iron and Steel Railroad Bridges	.25
Corfield's Treatment and Utilization of Sewage	4.50
Crandall's Tables of Excavation and Embankment	1.09
Cross's Engineer's Field Book (new ed.)	.25
DuBois' Strains in Framed Structures	10.00
Dunham's Plat and Profile Book,20 miles	1.00
" " " " 50 miles	2.00
Ellis's Fire Streams	1.50
Fanning's Water Supply Engineering	5.00
Flynn's Hydraulic Tables	.50
Flynn's Flow of Water in Open Channels	.50
Forney's Catechism of the Locomotive	2.50
Forney's Car Builders' Dictionary	3.00
Gilmore's Limes,Hydraulic Cements and Mortar	4.00
Gould's Specifications for Dams and Reservoirs	.25
Greene's Bridge Trusses, Graphical Method	2.50
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Grimshaw's Pump Catechism	1.00
Haswell's Engineers' and Mechanics' Pocket Book	4.00
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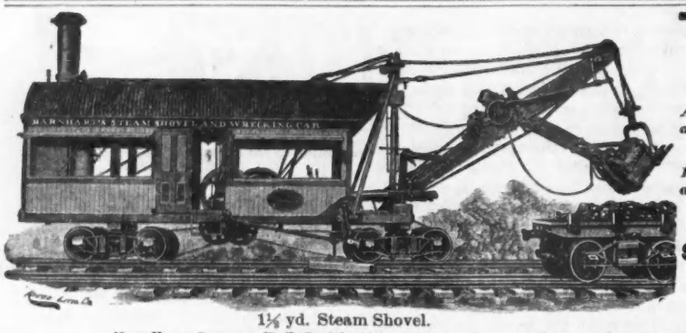

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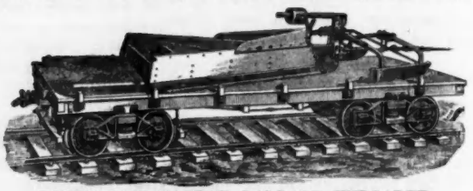

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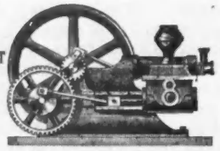

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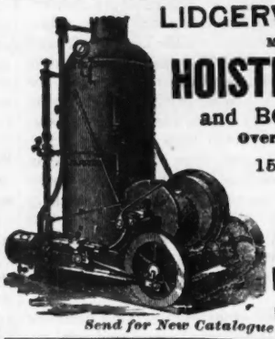

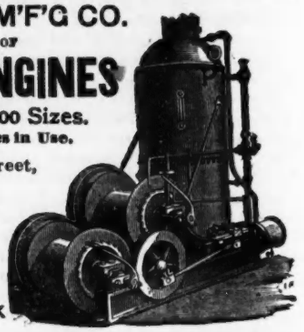

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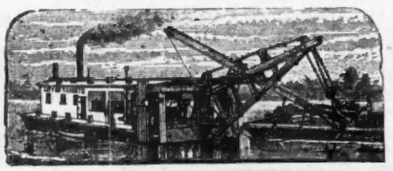

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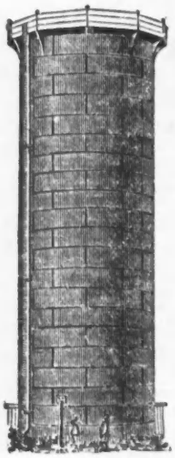

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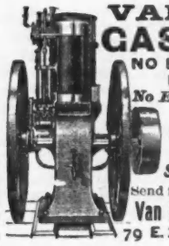

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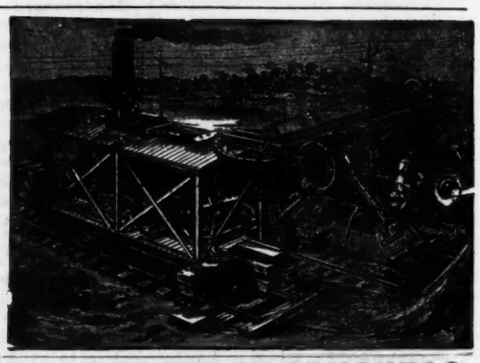

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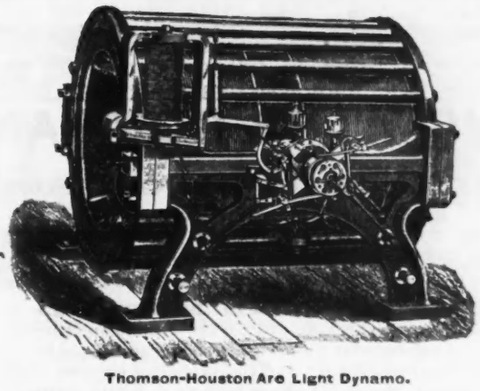

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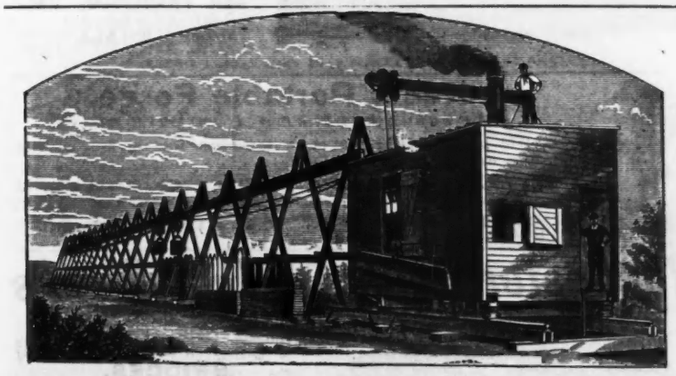

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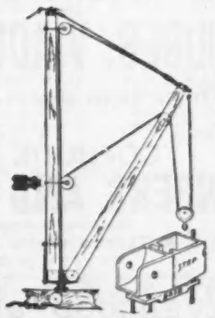

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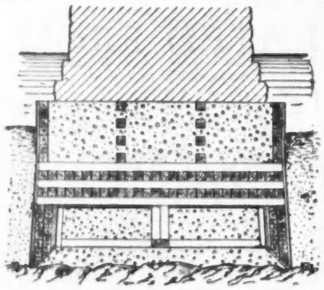

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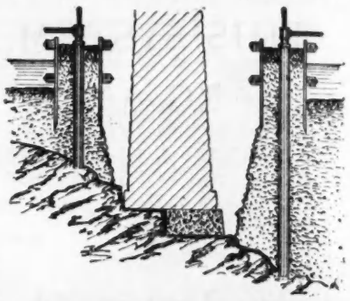

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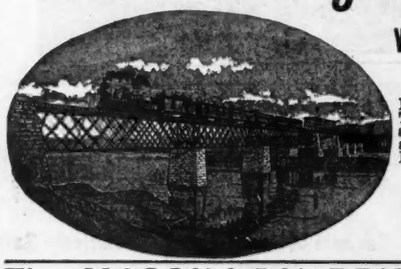

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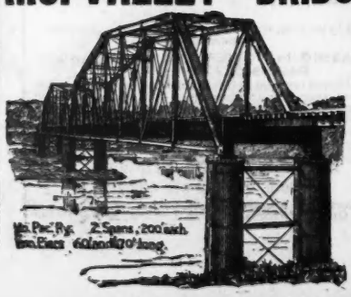

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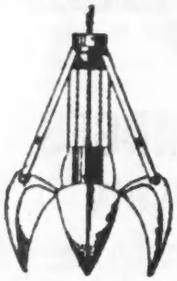

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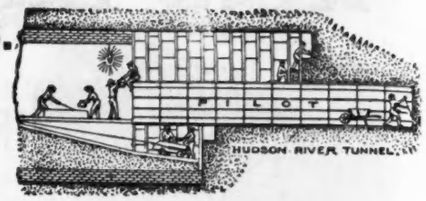

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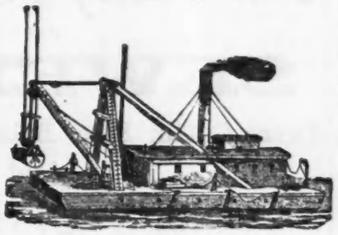

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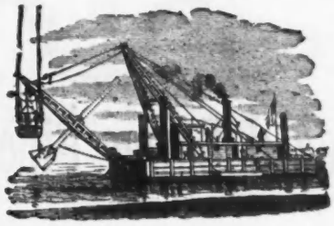

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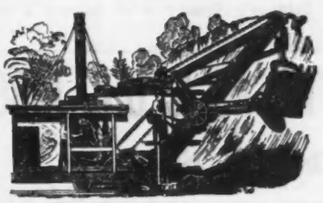

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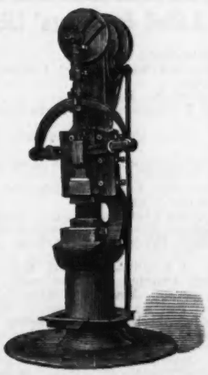

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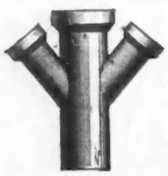

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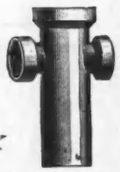

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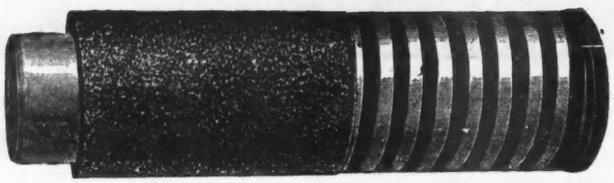

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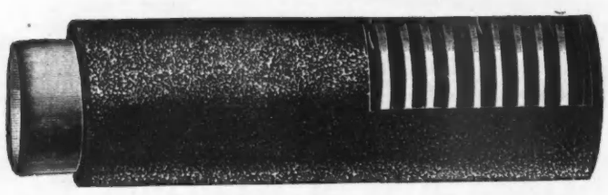

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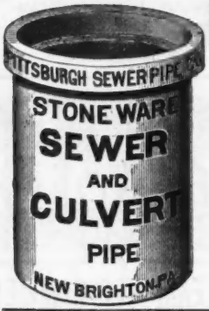

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June 1, 1889.

FORT RILEY, KANSAS, JUNE 20, 1889.—Sealed proposals in triplicate, subject to usual conditions, will be received here until 2 o'clock, P. M. SATURDAY, July 20, 1889, and then opened, for the construction of an iron or steel bridge across the Kansas River, at Fort Riley, Kansas. Specifications and information can be obtained from the undersigned; bidders to submit complete plans to conform thereto. Preference will be given to articles of domestic production or manufacture, conditions of quality and price (including in the price of foreign productions or manufactures the duty thereon) being equal. The U. S. reserves the right to reject any or all bids. Envelopes containing proposals should be marked "Proposals for Bridge" and addressed to GEO. E. POND, Assistant Quartermaster, U. S. Army. 26-4t

PROPOSALS FOR DREDGING IN PENOBSCOT RIVER, Maine, between Bucksport and Winterport. United States Engineer office, Portland, Maine, June 4, 1889. Sealed proposals in triplicate for dredging in Penobscot River, Maine, between Bucksport and Winterport, will be received at this office, No. 537 Congress Street, until 3 p. m., of TUESDAY, July 2, 1889, and then opened. Attention is invited to Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. All necessary information furnished by JARED A. SMITH, Lieut. Col. Corps of Engineers, U. S. Army. 24-3t

Colorado State Capitol.

Proposals for Cast-Iron Columns for the Colorado State Capitol Building.

Sealed proposals for furnishing 122 cast-iron columns, complete, in place, will be received by the Secretary of the Board of Capitol Managers until 1 p. m., mountain time, on Monday, July 1, 1889, and then opened by the Board.

The columns are to be put in place in the building as required, and properly set according to the plans and specifications, which are to be seen in the office of the Superintendent, P. Gumry, at the Capitol grounds, Denver, Colorado. These columns will weigh, when complete, with bases, capitals, lugs, etc., about 210 tons, more or less, but bidders must make their own calculations.

All proposals must be accompanied by a small sample casting, showing the quality of material and workmanship that the bidders proposes to furnish, and with a certified check on a responsible bank for the sum of $1,000 as a guarantee that the bidder will enter into contract to furnish and erect the columns at the prices bid, if the contract is awarded to him.

Proposals to be indorsed "Proposals for Cast-Iron Columns," and addressed to the Secretary of the Board of Capitol Managers P. O. Box 2291, Denver, Colorado, or delivered at the office of the Board, 44 Barclay Block, 1,755 Larimer street.

By order of the Board.

DONALD W. CAMPBELL, Secretary.

Denver, Colorado, May 4, 1889. 20-7t

Turnpike Roads.

HUNTSVILLE, Ala., June 6th, 1889.

Sealed proposals for constructing seventy-three miles of Turnpike roads in Madison County, Alabama, will be received until 12 o'clock, M. July 8th, 1889, at office of Probate Court, Huntsville, Alabama. Specification and blank forms for proposals will be furnished by W. C. CROZER, C. E., 71 W. Clinch St., Knoxville, Tenn., and by the undersigned at Huntsville, Ala. THOMAS J. TAYLER,

24-3t Judge Probate, Madison Co. Ala

Notice to Contractors.

Rock and Earth Excavation and Tunneling.

Sealed proposals will be received at the office of the company, in Ogden, Utah, until noon, July 20th, 1889, for the construction of the upper twelve miles of the Bear River Canal, from the Head works, on Bear River, Box Elder County, Utah, in accordance with plans and profiles and specifications on file in the office of the engineer in charge at Ogden.

The amount of work to be contracted for in the first section is approximately as follows:

220,000 cubic yds. Solid Rock.
19,000 cubic yds. Loose Rock.
1,528,000 cubic yds. Earth.
1,200 linear feet Tunnelling.

Contractors will be required to give a sufficient bond for the faithful performance of the contracts awarded them.

The company reserves the right to reject any and all bids. FRED MATHYAS,

26-4t Engineer in charge.

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For copy of contract and further particulars apply to

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CHARLES Z. McCORD,
Receivers,
Ga. Construction & Investment Co.,
15- Greenville, S. C.

Notice To Contractors.

Sealed proposals for the construction of sewers and appurtenances in Union, Church and Centre Streets, will be received by the undersigned at the office of JOHN M. HALL, Loomer Opera House, in the Borough of Willimantic, Conn., until 11 o'clock, A. M. of the 6th day of July, 1889, at which hour the bids will be publicly opened and read.

Each proposal shall be signed by the bidder, and accompanied by a bond of $200 conditioned for the execution of the contract within the time specified in this notice, in case the bid be accepted. The sureties of the bonds, both for the proposal and the contract, must be satisfactory to the sewer committee. No bid will be considered which has not responsible sureties upon its accompanying bond.

A certified check for $200 payable to the order of the Borough of Willimantic and enclosed with proposal, will be accepted in place of the sureties bond, if the bond for that case is properly filled out.

The person or persons to whom the contracts may be awarded will be required to appear with the sureties offered by him or them, and execute the contract within five days of the date of the award, and in case of failure or neglect so to do, he or they will be considered to have abandoned it, and as in default to the Borough of Willimantic.

The proposals must be made upon blank forms furnished by the sewer committee.

The form of agreement, specifications, and all information may be obtained at the office of JOHN M. HALL.

The engineer's approximate estimate of work and materials, by which the bids will be compared is as follows:

Trenching and laying complete.

886	lineal feet of	15	inch	vitrified	pipe	sewer,	
684	"	"	"	12	"	"	"
990	"	"	"	10	"	"	"
540	"	"	"	6	"	"	"

Furnishing materials and building complete 12 manholes. The Borough to furnish iron work and hubs for lateral sewers.

The right to reject any or all bids is reserved, if deemed for the interests of the Borough.

JOHN M. HALL,
E. S. BOSS,
GEO. W. MELONY,
Special Sewer Committee for Borough, of Willimantic.
W. G. SMITH, *Engineer.* 26-1t

PROPOSALS.

To Cast-Iron Pipe Manufacturers.

SPECIAL WATER COMMISSION OF THE CITY OF ALBANY, OFFICE, 25 N. PEARL ST., Room 18.

Sealed bids or proposals, addressed to the Secretary of the Special Water Commission, and endorsed, "Proposals for furnishing and delivering the iron pipe, branches and special castings for the pipe lines from the gang well station at the Troy Flats to the proposed engine house, and from the latter to the Bleecker and Prospect Hill Reservoirs," will be received at the office of the Special Water Commission until Tuesday, the 16th day of July, 1889, at 3 P. M., at which time and place the award of the contract will be made by the Special Water Commission as soon thereafter as practicable.

The approximate quantities of pipe needed are: 522 tons of 48-inch pipe and 6 tons of specials for the same; 3,450 tons of 42-inch pipe and 81 tons of specials for the same.

Blank forms of contract and specifications thereof, and of proposals, and all other information, and plans for the work, can be seen at the above office, after June 18, 1889, on application to the Secretary. Copies of contract, proposals and specifications can be obtained after June 24, 1889.

By order of the Special Water Commission.

A. VAN DER VEER, President.

H. E. SICKELS, Sec'y.

Dated Albany, N. Y., this 17th day of June, 1889. 25-3t

Notice to Contractors.

The Commissioners of Wood county, W. Va. will receive sealed proposals until 12 o'clock noon, July 10, 1889, at their office at Parkersburg, W. Va., for the construction of the foundations, masonry and necessary grading, etc. in connection with the Highway bridge over the Little Kanawha river at Parkersburg.

Plans and specifications can be seen at the office of the board on and after July 1st.

A bond to the amount of two thousand dollars will be required with each bid as a certificate of good faith—an additional bond, the amount hereafter to be determined, will be required of the successful bidder.

The Commissioners reserve the right to reject any and all bids.

LEVI STEPHENS, JR.,
R. N. CORBITT,
A. B. BECKWITH,
25-4t Commissioners.

Notice to Bridge Builders.

Sealed proposals will be received by the Joint Committee of the Board of Freeholders of the counties of Bergen and Passaic, N. J., until 3 P. M., Wednesday, JULY 3, 1889, for the construction of a Wrought Iron Highway Bridge across the Passaic River, at Rutherford Ave., Rutherford, N. J., together with the necessary piers and abutments.

The work to be done is as follows, viz:

To construct 3 spans of wrought-iron triangular girder of 100 feet span each, and of 3 piers, 2 abutments with wings and fenders at two of the piers.

Bids will be received for the construction of the bridge and masonry separately or together.

The bridge will be built in accordance with plans and specifications, which can be seen at the office of A. W. Van Winkle, of the Joint Committee of Rutherford, N. J., or at the office of Messrs. Wise & Watson, Civil Engineers at Passaic, N. J., and no other proposals will be entertained.

All proposals shall be endorsed upon the envelope, "Proposal for Rutherford Draw Bridge," and directed to Mr. SYLVESTER J. POST, Chairman of the Joint Committee, Passaic, N. J.

The Committee reserves the right to reject any or all bids if it be to the interest of the counties to do so.

Passaic Co.	Bergen Co.
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273,539	322,102	364,934
273,540	322,103	364,935
273,541	322,104	364,936
273,542	326,221	366,169
273,543	338,414	366,170
283,489	350,679	366,171
283,490	350,680	366,726
293,740	354,143	369,288
293,741	354,864	369,289
293,742	355,694	369,716
293,743	356,131	369,717
293,744	357,150	369,718
293,745	358,040	370,016
293,746	359,258	371,505
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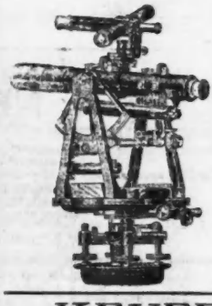

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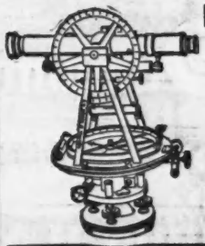

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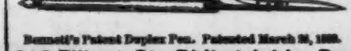

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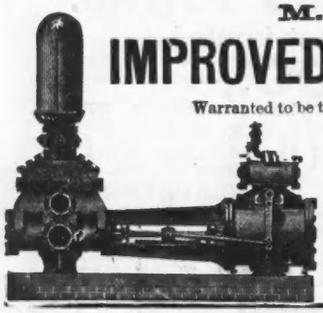

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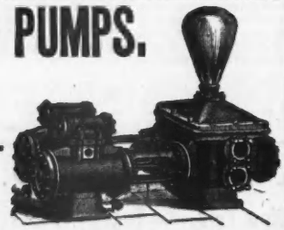

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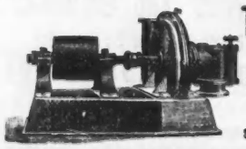

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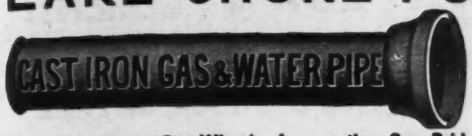

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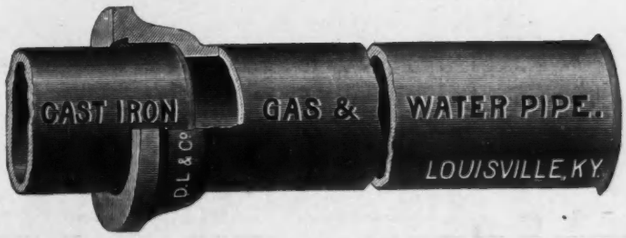

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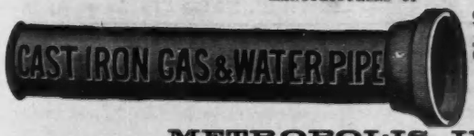

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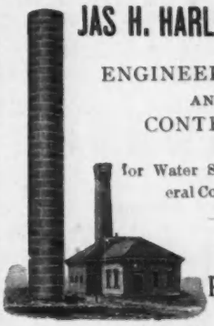

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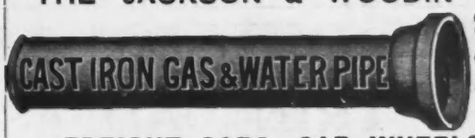

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